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Frequency Problems in Industrial Power Applications

Special Problems in Steel-Mill Drive—Discussion of Past and Present Tendencies and Developments Found to Be Factors in Determining Frequency Problems—Paper Before A. I. and S. E. and A. I. E. E.

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Some 15 years ago, recognizing the advisability for the standardization of certain requirements in connection with their work, the steel-mill engineers took up the question of choice of frequency. At that time all the electric power used by the steel mills was produced in their own plants, and, in many cases, such plants were of relatively large capacity compared with central stations. Apparently there was no question then regarding advisability of the generation of their own power, as this was the only way in which they could obtain the needed electric power.

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There were then only two frequencies in general use in this country, namely 25 and 60 cycles. The steel-mill engineers, therefore, confined themselves to a comparison of these two frequencies and their fitness for steelmill work in general. Various applications of electricity to steel mills then in use, and in contemplation, were gone into quite fully. The manufacturers of electrical and other machinery were consulted quite fully regarding the possibilities of the various types of apparatus and equipment. There were three conditions of service which required special consideration, namely, the operation of large very-low-speed induction motors, the transformation from alternating to direct current, and the parallel operation of slow-speed gas-engine-driven generating sets.

At the time this study was made much of the heavier service at the steel mills was contemplated at relatively low speeds with direct-connected motors, or with as little gearing as possible on the basis that large, high-speed, high-power gears would not be satisfactory. As motors up to 6000 hp. nominal rating with speeds of 75 to 90 r.p.m. were considered necessary in certain applications it appeared from all points of view that for such work 25 cycles was far better than 60, both from the standpoint of the general performance and first cost.

In transformation to direct current both synchronous converters, or "rotaries," and motor-generators were recognized as possible methods. With rotaries, 25 cycles offered by far the better proposition, compared with the 60-cycle rotaries of that time, whereas with motor generators there was not much difference. With induction-motor drive for motor-generator sets naturally the lower frequency appeared to offer advantages, while with synchronous-motor drive 60 cycles possibly was better. It must be borne in mind that in those days the high-speed d-c. commutating-pole generator, as we now know it, was not yet developed and, therefore, with the then relatively low speeds of motor-generator sets 25-cycle synchronous driving motors were fairly comparable with 60 cycles, while with induction-motor drive the advantage naturally was with 25 cycles. The coming of the commutating-pole d-c. machines, with consequent very much higher speeds, has greatly changed the situation.

The third condition mentioned—parallel operation—is one which principally concerned gas-engine drives. It was the belief that by using furnace gases with suitable large low-speed gas engines the most economical generation of power would be obtained. The Gary plant is an illustration of this early tendency. It was well known at the time that with 25 cycles parallel operation of alternators with gas-engine drive was a much

easier proposition than with 60 cycles, and even with 25 cycles there were some doubts regarding successful paralleling.

This Gary plant should be referred to further as an illustration of certain extreme conditions undertaken in some of the earlier pioneering in electrification of steel mills. Everything was more or less new and special in this electrification, and this was frequently cited as an illustration of an entirely electric driven steel mill. In this early plant there were many conditions of motor drive which, even with very-slow-speed motors, still required huge gears for still further reduction in speed. Some of the ultimate speeds at the load corresponded to six to ten revolutions with direct motor drive, obviously representing impossible conditions as far as direct motor applications were concerned. Even with gearing the conditions of motor drive were such that 60 cycles would have represented impracticable conditions, so that 25 cycles was a practical necessity in this plant as designed. This Gary plant had a very decided influence in fixing 25 cycles as a standard for steel-mill work.

Choice of 25 Cycles Made for Standard in Steel-Mill Service.

Taking all the various conditions into consideration the steel-mill engineers decided definitely upon 25 cycles as their future standard for generating plants. A standard voltage of 6600 was also decided upon, although this was not considered as of first importance, but practically amounted to setting an upper limit. It was felt that there would be considerable use for lower voltages, such as 2200, and, in fact, experience has shown that in the smaller plants 2200 volts is usually more satisfactory than 6600.

The choice of 25 cycles at that time was undoubtedly the correct one. With the knowledge and experience available it may be stated emphatically that no real mistake was made in this choice of frequency. It may be said, moreover, that if 60 cycles had been chosen instead of 25 cycles it is probable that steel-mill electrification would have been greatly handicapped in many ways and would not have reached nearly the stage of development that has been attained today.

However, new conditions have arisen in recent years which have changed the complexion of the problem to a certain extent. It was believed quite generally, 15 years ago, that 25 cycles would be the future power frequency of the country, on account of its general advantages in generation, transmission, utilization and transformation to direct current. If this was true of the general problem it applied still more positively to the steel-mill situation. The whole trend for large power service seemed to be toward 25 cycles, but for lighting purposes 60 cycles was favored as being by far the more desirable frequency.

From the central-station standpoint, however, the situation gradually changed. One of the big handicaps of the 60-cycle system was in the greater difficulties in transformation to direct current. The 60-cycle rotary converter, while operative in a fairly satisfactory manner in some applications, was considered quite unsatisfactory in others. This, therefore, meant that motor generators were required to a considerable extent in connection with 60-cycle generating plants, while with 25 cycles rotary converters were used almost exclusively. Thus the large generating plants for operating d-c. railway service, and those for operating the 3-wire d-c. Edison systems, went almost exclusively to 25 cycles mainly on account of the advantages of rotary converters over motor generators. However, improvements in the 60-cycle rotary converter, making it a better operating machine, appeared about 15 years ago, but the machine being of the non-commutating-pole type was of relatively low speed with many poles and was unduly complicated, expensive and inefficient. The coming of the commutating poles in d-c. generators was naturally followed, although several years later, by the use of similar poles in rotary converters, beginning about 1911. At first the use of commutating poles on rotary converters was considered as unnecessary, and simply in the nature of a refinement, due to their relatively low speeds, and there was some truth in this. However, the use of commutating poles on rotaries immediately opened the way to very much higher speeds, so that within a year or two after their real introduction the speeds of both 25 and 60-cycle rotaries began to climb at a rapid rate. Here, however, the 60-cycle rotary had the advantage, for soon the 25-cycle machines reached their limiting minimum number of poles, where the 60-cycle machine could go to materially higher speeds before reaching such limits. Consequently in this race toward higher speeds the 60-cycle rotary, in the smaller capacities especially, soon outran the 25-cycle, while in larger machines it made such a good showing relatively that it put the 60-cycle generating system nearly on a par with the 25-cycle system from the standpoint of transforming to direct current. Here was a big step in favor of 60 cycles.

Tendency Towards Higher Speeds in Development of Induction Motors.

In the development of induction motors, the tendency also was toward higher speeds. In the small sizes of 25-cycle induction motors there is not much choice in speeds on account of the few combinations of poles which are possible. Here 60 cycles presented material advantages in offering very much higher speed machines for general power purposes, with resultant lower first costs. Speeds of 1200 and 1800 r.p.m., corresponding to six and four poles respectively, became common practice on 60 cycles, whereas 750 r.p.m. was practically the nearest corresponding 25-cycle machine. Of course, 2-pole, 1500-r.p.m., 25-cycle machines are possible, but it happens that for constructive reasons the 2-pole machine does not show any material advantage in cost or otherwise over the 4-pole machine.

From a third standpoint, namely, power generating units, 60 cycles also soon presented advantages. In the earlier days of the turbogenerator the 25-cycle, 2-pole, 1500-r.p.m. unit was favored over the 60-cycle, 6-pole, 1200-r.p.m. machine of corresponding capacity. However, in the race toward higher speeds, which has occurred in the turbogenerator practice as well as in other lines of electrical design, the 1200-r.p.m., 6-pole machine was dropped in favor of the 1800-r.p.m., 4-pole machine, thus putting the advantage somewhat in favor of 60 cycles. Moreover, up to 5000 kw. a 3600-r.p.m., 2-pole machine at 60

cycles became possible, whereas the best that the 25-cycle frequency could offer was 1500 r.p.m.

Special Features Influencing Transformer Design.

In transformer development in the early days it looked as if 25 cycles had all the advantage, due to the fact that the iron losses were relatively much lower so that the iron in the magnetic circuit could be worked at very much higher flux densities. However, with improvements in the quality of transformer steel, such as the introduction of silicon steel, it was found that with either 25 or 60 cycles the flux densities could be worked up to such a point that saturation of the magnetic circuit, and in consequence the magnetizing current itself, became one of the limiting conditions. Thus 25 cycles represented simply lower losses in the transformer iron, which were more than counterbalanced by the increased quantity of iron required, so that the advantage began to be on the side of the 60 cycles; and in later development the 60 cycle transformer, as a rule, has proved to be materially smaller, lighter and cheaper than its 25 cycle competitor.

Thus it may be seen that there were strong reasons for the trend toward 60 cycles for general power generation and distribution. The transmission advantages at first seemed to be in favor of 25 cycles, but transmission voltages soon rose from 11,000 to 22,000, 66,000, 154,000, and now 220,000 is to be tried out. With these higher voltages the 60-cycle transmission has proven to be sufficiently satisfactory; so that taking generation, transformation, transmission, distribution and the nature of the load into account the sum total of the advantages have been considerably in favor of 60 cycles.

Another consideration must be taken into account, namely, 15 to 20 years ago large central stations for general power supply were almost unknown. There were lighting stations, railway stations and power stations furnishing individual industries, but there were practically no central stations for the general supply of power for all purposes as have been developed during the past few years. With the gradual recognition of the advantages of centralized power plants the smaller lighting and general power distributing stations began to expand and reach out toward the isolated and special service plants. Gradually as the central stations increased in capacity they began to make special power rates to railway companies and to industrial plants, which were better than they could obtain from their own generating plants. Consequently there was soon a tendency toward shutting down the individual plants with purchase of power from the central plant. This action has been cumulative, for the more load taken over by the central plant the bigger the central plant became, and the better rates it could make, etc. In this growth the tendency has been very largely, and in recent years almost exclusively, toward 60 cycles as a general purpose frequency.

Central Station Companies Make Bid for Steel-Mill Load.

In reaching out for more load these large central power plants have gone after the steel industry along with other industries, and here is where the steel-mill problem of frequency has become prominent. As many of these steel mills, especially the older ones, are already equipped for 25 cycles the problem has been that of best adapting the 60-cycle frequency where power is to be purchased. In the former days the steel mill could compete quite favorably with the central station in the cost of power. However, with the increased growth of the central power stations and their lower rates for power the steel mills are naturally strongly tempted toward the purchase of power. Even though the steel power plant may be able to generate power as cheaply as it can be purchased it still is not in itself an attractive investment as capital is not, as a rule, invested in the steel industry without the expectation of a reasonable return. As some of the steel-mill engineers have said, their business is to produce steel and not manufacture power, and, naturally, they cannot compete in many cases with those whose sole business is the manufacture and sale of power.

One condition which now lends itself toward the use of 60 cycles in steel-mill work has been the increased use of gearing thus allowing higher speed motors. For many kinds of service gearing is now used where direct connection was considered as the only method a few years ago. In consequence the speeds of the motors used in steel-mill work will average much higher than a few years ago.

On the other hand, however, there are certain prejudices against large gears for heavy service, based to a large extent upon more or less unfortunate experiences, but through greater experience and with more suitable types of gears this prejudice is disappearing to a very great extent. As in everything else there has been considerable development in the gear situation to meet many of the applications, and while there may be individual cases where gears are not looked upon favorably, yet it must be admitted that the general tendency in recent years has been quite strongly toward higher speed motors with gearing. Regardless of whether or not it represents the best engineering the trend is toward such gearing, and, as a rule, where a trend persists it must sooner or later become recognized as desirable practice. The law of the survival of the fittest holds in steel-mill machinery as well as in everything else.

Slow-Speed Motors Can Be Built for Either 25 or 60 Cycles.

Of course, it must be borne in mind that operative slow-speed motors can be built as well for 60 cycles as for 25 cycles, but with either lower power-factor or with high cost. In some cases lower power-factor may not be an important item. With equal power-factors a slow-speed, 25-cycle induction motor is inherently smaller and cheaper than the corresponding 60-cycle motor. This is a fundamental difference. On the basis of equal costs of motors with quite different power-factors additional cost of power-factor correction should be included to make the two entirely comparable. It is, however, only in the slow-speed induction motors that the 25-cycle type represents any material advantage. If, therefore, a plant should be made up largely of slow-speed induction motors the 25-cycle frequency would represent a most nearly ideal arrangement. How-

ever, there are few plants, if any, where the larger part of the total power is utilized in such motors. Taking all the other service into account it will probably be found that there are very few plants where 60 cycles cannot now make practically as good a showing as 25 cycles. In other words, where the slow-speed service represents but a relatively small part of the total service it may be better to make some sacrifices in this smaller part to the advantage of the whole.

The question of purchase of 60 cycle power is dependent, of course, upon many conditions. In the Pittsburgh district, for instance, the total electric power used in the various steel mills may represent the equivalent of a huge power plant in itself. In consequence, if the various mills were to combine their power plants into one general plant the capacity of such a plant and the conditions of operation would probably be such that it could compete quite favorably with any large central station, and in such case 25 cycles could be the frequency. Moreover, this would remove the manufacture of power from the mills themselves and place it in a plant whose sole business would be the manufacture and supply of electric power. It may be suggested at this point that at present furnace gases are used to a greater or less extent under the boilers for power plants, and that with the power plant placed elsewhere these gases would be wasted. However, there is not much doubt but that other uses would be found for such gases, and, in fact, some of the steel mills at present can find other uses for all furnace gases.

In considering a single large power plant the Pittsburgh district represents unusual conditions in that there is a concentration of many huge steel plants within one relatively limited district. A combined steel power plant in the Pittsburgh district would, therefore, represent a special rather than a general condition and would furnish the solution of the problem for only one general district. In other districts the problem of 60 cycles versus 25 cycles would still hold and would have to be met. It is the general problem rather than a special one which should be considered broadly.

With this question of purchase of power before them a number of the steel mills throughout the country, which have been planning to increase their power plants, are faced with the question of installing an additional plant at 60 cycles instead of 25 cycles; also, with their existing 25 cycle plants, the purchase of additional power at 60 cycles involves numerous problems in the application of such power to the existing equipment. Various suggestions have been made from time to time as to how to handle this situation in its various forms. Probably as good a way as any to look into the problem would be to classify the various methods by which the double-frequency situation could be met. These methods may be given as follows, the order in which they are given, however, not representing their expediency or importance:

(1) Rebuilding, or obsoleting, existing plant and replacing entirely with 60 cycles.

(2) Conversion of 60-cycle purchased power to 25 cycles by frequency changers, and operating in connection with existing plants. This retains the advantage of the existing 25-cycle system, but means considerable losses due to the frequency changers.

(3) Allowing the existing 25-cycle plant to remain in service and installing new generating and motor equipment for 60 cycles. This would allow purchased 60-cycle power to be utilized in connection with the new generating plant. This, however, involves a more or less mixed system throughout the plant.

(4) Retaining the existing 25-cycle plant for those parts of the service where 25 cycles is materially better, and changing other parts to 60 cycles for use on purchased power. This could be continued until the old plant and equipment became obsolete. This would probably mean a mixed system throughout the mills for years to come.

(5) Utilizing the existing plant within certain areas and applying 60-cycle purchased power to extensions and new areas. This involves a double system, but not a general mixture of two systems in the same area. Eventually if the purchased power proves more satisfactory than the local supply the latter could gradually be obsoleted. This means, however, that in the new areas the 60-cycle energy would be applied to slow-speed motors as well as all other apparatus.

Looking at the matter broadly it does not seem advisable to generate two separate frequencies in the local plant, so that if 25 cycles is the existing frequency it is not desirable to put in an additional generating plant at 60 cycles, unless such new equipment is to be of greater capacity than that already installed. In this latter case it might be advisable to put in the additional plant at 60 cycles, simply with the understanding that the 25-cycle plant will soon be superseded entirely. Wherever the additional plant is to be less in size than the plant already installed, or simply represents the normal growth, then it appears that it would be better to put in the additional plant at the same frequency rather than mix the two frequencies.

Some of the large central stations throughout the country have encountered a similar problem, and in some of these cases both 25 and 60-cycle generating units have been installed in the same power plant, but, as a rule, they supply quite different service and areas. For instance, the 25 cycle service will be utilized almost entirely by conversion to direct current, and within a given district this will apply exclusively. In other cities the 60 cycles may be represented by entirely separate power plants supplying outlying districts mostly, a large part of the application being by direct service instead of by conversion to direct current. In the earlier days where 60-cycle service came into considerable demand in connection with 25-cycle plants, frequency changers were installed in many cases. As the 60-cycle service grew, instead of adding more frequency changers, the practice has been to install 60-cycle generating units—often in separate power plants—the existing frequency changers then being used as a tie between the two plants. In those cases where the capacity of the two power plants has been considerable compared with the capacity of the frequency changers tying them together there have been certain conditions of unusual stresses in the frequency changers at times of severe load conditions. This problem of the two frequencies

has been one of long standing with the central power stations, and as the present solutions are more or less a development from experience this is possibly an indication that steel mills should follow along somewhat similar lines.

It has been suggested that in the application of 60 cycles to steel mills, this might be used largely for one kind of service, such as the motor generators or rotaries for producing direct current. In this way the 60-cycle service need not be distributed so generally throughout the mills, but would simply be supplied to the converting machinery which is not scattered through the mills in the same way as the motors. Moreover, the modern 60-cycle synchronous motor generator is just as cheap and economical as its 25-cycle competitor, or cheaper in some cases, while the 60-cycle rotary converter if transformers are included approaches pretty close to the 25-cycle machine in general operating characteristics.

In existing mills, however, changing to 60 cycles would mean replacing or remodeling the existing motor generators and rotaries, and unless the future growth of such apparatus is to be large compared with that already installed this reconstruction or replacement might prove in the end to be relatively expensive. Even if the existing machinery is more or less out of date, unless it has uneconomical characteristics, it can probably be kept in service for many years to come, for much of this machinery is well built and of durable construction and may still have 20 to 30 years of good operative life. In fact, some of the motor generators and rotary converters which have been in operation for 10 to 20 years in steel mills appear to be as good as when first installed, and it will be difficult to justify their obsolescence and replacement.

Uses and Applications of Frequency Changers in Steel Mills.

As stated before, the function of the frequency changer is simply to change frequency at a considerable expense in power. There are other objections outside of inefficiency which count against the frequency changer, but these probably would not be dominating or controlling in themselves. On the face of it, the frequency changer seems to furnish such a simple solution of the frequency problem that in some instances it might pay to sacrifice other considerations in favor of simplicity.

It must be kept in mind that there are no means for getting the exact 60 to 25 relation with an economical type of machine, for the numerical ratio of 60 to 25 only allows a 24-10-pole combination, which represents a rather low speed except for units of enormous capacity. If any other more economical combination of poles is chosen, such as 10-4 or 14-6, then, with a 60-cycle supply system, some other frequency than 25 cycles will be obtained. The 10-4-pole combination gives 24 cycles, while the 14-6-pole combination gives 25.7 cycles. Therefore, for either of these combinations it would be necessary to change the steel mill frequency slightly, for it would be almost impossible to get any general power company to change its frequency of 60 cycles. Naturally, if either of the above combinations were to be adopted the 10-4-pole system would be preferable from the standpoint of the frequency changer itself. However, there might be some question regarding the use of 24 cycles instead of 25 cycles in steel-mill applications, for this means a general reduction of 4% in the speed of all the synchronous and induction motors. Thus the choice of the most advantageous speed for the frequency changer may possibly represent a material disadvantage in the motor equipment. Again, the use of the 14-6-pole frequency changer would mean increasing the mill frequency about 3% which should not be as objectionable as a reduction of 4%. However, the 14-6-pole combination would not represent nearly as cheap frequency transformation.

As an effect to the cost of the frequency changer and its losses, there may be considerable saving over the installation of corresponding capacity in additional power generating plant. In installing new or additional power plant the cost of the electric machinery represents but a small part of the total cost and, unquestionably, the extra buildings and equipment to go with the frequency changer would be very materially less than that of additional generating plant. This saving in first cost might go a long way in some cases toward offsetting the losses of the frequency changer, especially in those cases where 60-cycle power can be obtained at a low rate.

As soon as two or more frequency changers are to be installed in one plant, these to be operated in parallel with each other and with the existing generating plants, then complication comes in, possibly to such an extent as to lose most of the simplicity of the scheme. The synchronizing and proper paralleling of two or more frequency changers with each other and with their respective power plants, is one of the "fussy" things which can be carried out successfully, but which nobody likes.

Attention should be called to the fact that if any particular combination of frequency-changer sets is chosen, such as represented by 10-4 poles. or by 14-6 poles, then this exact ratio must be retained throughout if additional frequency changers are ever to be added to the plant. As to the capacities of such apparatus which are practicable in single units, 10-4-pole sets of 5000-kv-a. capacity have been offered recently by manufacturers. However, for larger capacities than 5000 kv-a. certain difficulties arise, as the next possible pole combination is 20-8 which represents just half the speed. In consequence, even with a 10,000-kv-a. set, halving the speed will probably more than offset the gains in cost and efficiency resulting from larger capacities. One would assume that two 5000-kv-a. units would be preferred to one 10,000-kv-a. unit, and presumably this is correct if the two units can be operated independently. For parallel operation, however, the added complexity might be considered sufficient to offset a slight increase in cost of the larger single unit.

Cost and Efficiency of Units of Different Sizes.

For costs and efficiencies of such apparatus the following very approximate figures are suggested: For a 5000-kv-a. set including auxiliaries, switchboard appliances, etc., from $10.00 to $11.00 per kv-a. The combined efficiency will be approximately 92% or better at full load and

89% or better at half load. For a 10,000-kv-a. set, having 20-8 poles, the cost per kv-a. could be taken roughly at $11.00 to $12.00. No figures for efficiency have yet been worked out. Neither of these approximations include cost or efficiency of stepdown transformers.

There is one other class of electric machinery used in steel mills where the effect of frequency has not yet been considered, namely, in the induction-motor speed-regulating sets which have come into use to a considerable extent in recent years. There are three types of such speed-regulating appliances in use today, all of them requiring communicating machinery, as follows: (a) Those in which the secondary electrical power of the induction motor is transformed into the mechanical power and utilized as such; (b) where the secondary electrical power is transformed into direct current and utilized, and (c) where the secondary power is transformed from the variable or adjustable frequency of the secondary to some fixed frequency such as that of the line and thus utilized. The first of these schemes involves polyphase commutating-type motors, while the second requires rotary converters, and the third requires commutator-type frequency changers which are a more recent development than the other types of machinery mentioned.

From the standpoint of commutation (a) and (c) present considerable advantages in first cost, general performance and efficiency at 25 cycles, as compared with 60 cycles. Method (b), involving rotary converters, makes its best showing at 60 cycles, although all three arrangements are practicable at both frequencies. Arrangements (a) and (c) allow satisfactory operation both above and below the synchronous speed of the induction motor, whereas, (b), heretofore, has only been worked below synchronism, although auxiliary means may be found for this scheme just as with the other two for successfully passing the synchronous-speed condition. All these methods of speed control could doubtless be used to a considerable extent, depending upon the conditions and the application, but as they can be operated successfully on both 25 and 60 cycles apparently they will have no controlling influence on the choice of frequency.

No Good General Solution of Frequency Problem Yet Obtained.

In conclusion it may be said that there is no good general solution to this frequency problem, and each case must be handled on its merits taking the future tendencies and growths into account. In many cases it appears that the large existing 25-cycle local systems should be retained at least until such time as the need for replacement is more obvious than at present. Unless the future service of the mill shows strong indications of going almost entirely to 60 cycles a mixed generating plant is not to be recommended. In those cases where existing 25-cycle power and purchased 60-cycle power are both to be used they should at first have their own individual services or areas as far as possible to avoid indiscriminate mixing of services throughout the mills, and to avoid freqency changers with their attendant losses unless conditions are such as to warrant their use. In general, where both frequencies are liable to be used for some time to come, and there is any real necessity for a tie between the two, then frequency changing becomes a necessity. However, as central-station service has now become quite reliable there is not the need for a tie between two frequencies that was formerly the case, so that doubtless, in many cases, frequency changers can be dispensed with.

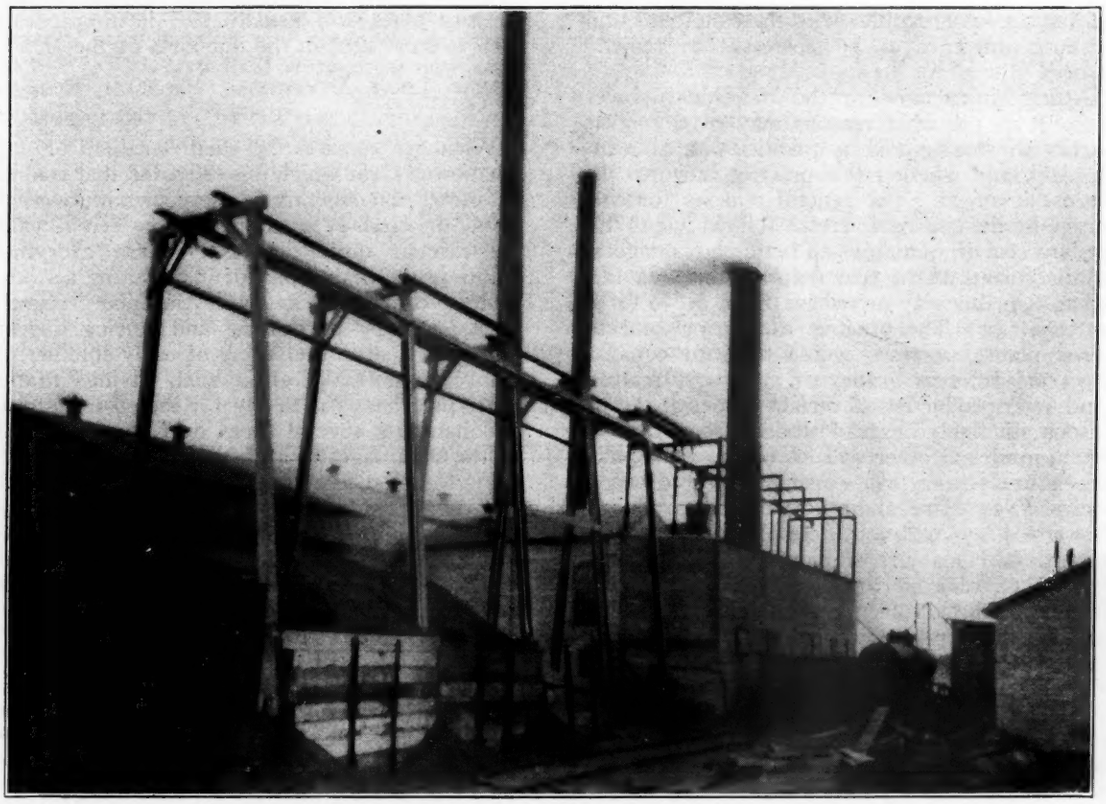
In case of a new plant, in general, it should be installed at 60 cycles, if located in a 60-cycle district, simply on account of future possibilities. There is no question whatever that future central stations will supply power for general purposes at 60 cycles within certain large districts, the trend being too strong to be changed or controlled. In other large districts it will be principally at 25 cycles, as in the territory served by Niagara, for instance. There will be still other cases where both frequencies will be used, simply because the field for 25 cycles is already so large that 60 cycles cannot replace it. In New York City, for instance, 25 cycles is already in use on such a vast scale (1,099,600 kv-a. 25 cycles and 217,000 kv-a. 60 cycles) that it may be almost a lifetime before the 60-cycle service overtakes it. But the present growth in 25 cycles appears to be limited to existing plants which may never be replaced by 60 cycles. In consequence of this mixed service the ultimate solution of the general supply problem may mean 60 cycles for general purposes with 25 cycles as an auxiliary supply. It may be assumed that in those cases where 25 cycles present such advantages that the consumer will put in his own generating plant, if necessary to obtain such service, that eventually the general power service will find some means for supplying the individual needs.

SALESMEN ATTEND MOTOR SCHOOL AT FACTORY.

The Western Electric Co., in conjunction with the General Electric Co., has organized a power-apparatus class at the factory in Lynn, Mass., to acquaint the members of its sales force with the manufacturing conditions which prevail in the production of motors, generators and the like. Classes are being conducted each month with an average attendance of 15 salesmen. The "business boosters" of the company are kept busy for a week under supervision of a corps of motor specialists. Motor parts, single-phase motors, polyphase motors, control apparatus, motor characteristics and all their kindred subjects are included in the studies.

Shop instruction is one of the most important parts of the course. The classes inspect every process of construction from the bare shafts to the finished motors. Attention is also given to the various uses to which power apparatus can be put. J. L. Ray, power apparatus sales manager of the company, is the originator of the new school. The personnel of the first classes were members of his company's sales organizations at New York, New Haven, Boston, Syracuse and Philadelphia.

Present-day life is dependent upon the maintenance and the continuance of the public-utility system. Without the thousands of utility organizations civilization would be stagnant.



American Trolley Carrier System of Coal Storage and Handling Equipment at Plant of Union Tool Co., West Chicago,

Coal Storage a Factor in Power Plant Economy

Storage by Railroads Tends to Reduce Coal Cost—Purchase at Favorable Time Makes for Reduced Fuel Bill—Type of Storage System Depends on Space Available and Quantity to Be Handled

By ROBERT JUNE

Coal storage is a subject which is being given more and more consideration each year by power-plant operators. There are a number of reasons for this increased appreciation of the advantages of coal storage. Not the least of these is the danger of expensive shut-downs due to strikes by miners or transportation workers. There are excellent reasons why coal storage should be resorted to by power-plant operators, by railroads, and by mine operators. We, of course, are concerned with the power plant, but because coal storage by railroads and mine operators offers some indirect advantages to the power-plant operators we may mention the reason for such storage, briefly, without discussing the means.

As far as the railroads are concerned $1,000,000 invested in coal-storage facilities is equivalent to $3,000,000 invested in locomotives and cars, if purchased for coal-moving purposes only. This is true because railroads are called upon to move coal in large quantities only through three or four months of the year, and if they have sufficient facilities to meet this peak load there is a large portion of the year when the rolling stock will be idle. Another reason for coal storage by railroads is that it permits the railroads to haul their own coal at times when the equipment can best be spared for this purpose, so that the equipment need not be taken from earning service to do nonproductive work.

Reason for Coal Storage at or Near the Location of the Power Plant.

Coal storage is important to the coal operator, inasmuch as proper facilities for this purpose will enable him to regulate production and maintain a uniform output at the mines. As matters stand, the average mine is operated approximately 170 days per year, and we would have fewer mines in operation, smaller overhead, and more contented labor, if all mines were equipped with coal storage so that coal could be mined when cars were not immediately available. Inasmuch as lack of coal-storage facilities by railroads and coal operators is one important factor in the present high cost of coal it is important that every

coal user become familiar with the conditions and use such influence as he possesses to remedy them.

Getting down now to the individual power plant, let us see what reasons may exist for the practice of storing coal in quantities at, or near, the plant, and whether this practice is worth the expense involved. The general reasons for coal storage by the consumer are as follows: (1) He can buy coal in quantities to better advantage at certain seasons of the year than at others, saving, perhaps, in this way anywhere from $0.50 to $1 per ton. (2) The practice of storing coal by power plant operators would tend to equalize prices on different grades of coal. As matters stand, over production of certain grades at certain seasons of the year, and under production of certain grades at other seasons of the year, tends to penalize power plants using certain of these grades. (3) Mine and railroad strikes, embargoes and delays will not affect plants where large quantities of coal are stored. (4) The general practice of coal storage at the nation's power plants would help tremendously in solving the national situation by providing miners with steady work (hence at lower wages per ton of coal mined).

The question as to whether coal should be stored in the individual plant will depend entirely upon the conditions obtaining in the particular case. It is out of the question, for instance, to store coal in or near a power plant situated in the business district of a large city. Here space is entirely too valuable for any such purpose, and unless the needs of the plant are extremely large, and the source of supply somewhat uncertain, the city plant will usually find it impracticable even to store coal in the outskirts of the city.

Cheap Land Simplifies Problem of Coal Storage.

When we come to the small, medium or large size power plant which is so situated that coal can be stored conveniently in close proximity to the plant, on land of medium or low rental value, the case is quite different. Here everything points to the desirability of maintaining a storage system commensurate with the plant requirements, and by purchasing and storing a year's supply of coal in the spring or early summer, the plant can normally effect such savings in purchase price alone as to pay for the cost of storage and handling several times over, to say nothing of the advantages of an assured supply of fuel.

As to a choice of mechanical means for effecting coal storage, this will depend entirely upon the location of the plant and the storage pile and the amount of coal to be handled. In previous articles we have discussed various types of coal handling equipment such as the mono-rail, bucket, chain and flight conveyors, etc., and it is not necessary to again describe this equipment. It should be noted, however, that in many cases, particularly where the quantity involved exceeds 10,000 tons, the locomotive crane with grab bucket appears to offer an economic solution. In planning coal storage for very small plants it may be well to remember that coal can normally be hauled cheaper by wheelbarrow than by cart, up to a distance of about 250 ft.

In determining a storage system to be employed, most, if not all, of the following points

Loading Pit and Hoist for Coal-Handling System at Plant of Union Tool Co., West Chicago, Ill.

will have to be taken into consideration: (1) Character, size, location and value of available ground. (2) Desired total storage capacity and amount of coal which may have to be loaded or unloaded per day. (3) First cost of storage system and costs of maintenance and operation. (4) Percentage of breakage which can be allowed in handling coal. (5) Length of time coal must be kept in storage. (6) Effect, if any, of climate. (7) Adequate available water supply. (8) Means for rapid loading out of coal in case of fire.

In considering a storage plant from an economic point of view it must be remembered that if the equipment is in operation very irregularly costs are consequently higher per ton, because of the heavy fixed charges for interest and depreciation.

We have spoken of the locomotive crane as a generally cheap and satisfactory means of handling coal for storage in the usual boiler plant. The special advantage of the crane, of course, is that its functions need not necessarily be confined to the coal pile, as it can often be employed for other purposes about the plant yard. The locomotive crane is also adapted to quite a variety of storage systems, being particularly suited to various "circular" types of storage.

Where locomotive cranes are used with large circular systems the gage of the track on which the crane runs is important. When possible the gage should be approximately as indicated in the accompanying table. In planning large circular storage systems the usual arrangement is one whereby the coal is discharged from railroad cars into a pit at a central point, which pit is also the center of the circular track system on which the crane operates, the radius of the circular track being equal to the maximum swing of the crane. With such a system the locomotive crane can pick up coal from the dumping pit when standing at any point on the circular track. By a swing of the boom the coal can be deposited at any point inside or outside the circular track as far as the boom can reach. While it would be feasible to do so, it is not considered good practice to cover up crane tracks, since it is very desirable to be able to operate the crane over the entire range of the storage pile in case of fire. This feature, limiting the capacity of a given space, often turns the balance of advantage in favor other equipment capable of utilizing the entire available area.

Characteristics of Different Coals Have Decided Influence on Storage Problems.

Some coals may be stored with greater safety than others. Danger from spontaneous combustion, however, is more apt to be present as a result of improper piling of coal than because of the kind of coal stored. In storing bituminous coal the important consideration, as far as freedom from spontaneous combustion is concerned, is to see that fine coal and dust are not present. This would seem to preclude the storing of slack coal and run-of-mine, which are precisely the grades which many boiler plants wish to store. It may be said that it does preclude the storing of this kind of coal in the open air as far as safety from fire is concerned. However, where provision can be made to flood or to rapidly load out the coal which has caught fire there is no special reason why run-of-mine and slack coal should not be stored.

Spontaneous combustion is principally due to oxidation taking place on the surface of the coal. With very fine coal there is immensely greater surface presented for oxidation than with lump coal, consequently the danger of fire is very much greater.

If lump coal alone is stored the danger of spontaneous combustion is practically eliminated. Coal which has gone over a 1.5-in. screen can be stored with little danger of fire. Coal with screenings removed has been kept in storage for many years without firing. Where one has choice of coals for storage purposes, selection should be made of the coal which is least friable because less dust and slack will be produced in handling. Run-of-mine and slack coal have at times been stored without fire occuring by the exclusion of air from the interior of the pile. Such exclusion may be accomplished by a closely sealed wall built around the pile, or by close packing of the fine coal. However, securing of satisfactory results by such methods is both difficult and uncertain. Many men with experience in storing coal believe that wet coal, or coal stored in a damp place, is peculiarly liable to spontaneous combustion.

If fires are absolutely to be prevented in the storing of run-of-mine or slack coal the only satisfactory means is by under-water storage. Coal keeps indefinitely in good condition under water, losing none of its heating value and absorbing comparatively little moisture. Water storage possesses a further advantage in that coal does not deteriorate in physical properties, such as slacking. The cost of under-water storage is, of course, an important item, and may be so great as to preclude the use of this system. Where old quarries or abandoned clay pits are available for under-water storage they may be at times adapted with smaller initial expense than would be required for other systems.

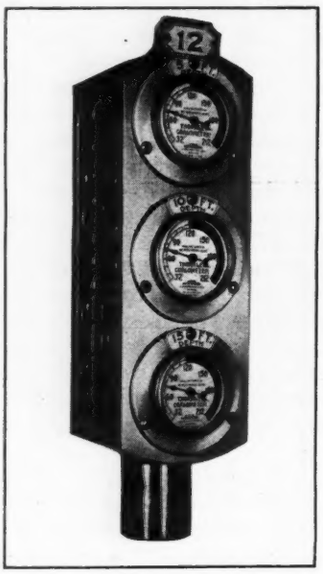
Methods of Piling Coal to Facilitate Handling and Avoid Fires.

To store coal successfully the pile must be so arranged that the heat generated will not exceed the losses by radiation. Coal freshly mined has a special tendency to oxidation and heat. This property pertains to all varieties of coal, though it varies in intensity. The liability of spontaneous combustion occuring decreases with the period of time elapsing between the mining and storing of coal; hence, coal should be exposed to the air as long as possible before being placed in the pile.

To avoid spontaneous combustion one of two principles should be observed; either the coal should be piled so that air may circulate freely through it and thus carry off the heat due to oxidation, or the coal should be so closely packed that air cannot enter the pile and cause oxidation of the fine fuel. Unless care is used in piling stratification of the different sizes of coal in the pile may occur. This is a dangerous condition, since the open space between the coarse lumps of coal provide a passage through which air may enter and come in contact with the fine coal, giving the opportunity to start combustion. In this connection it is well to remark that it is not con-

sidered good practice to mix indiscriminately different kinds of coal in the storage pile, as experience has shown that this almost invariably leads to the starting of fires. It has further been noted that coal of high oxygen content seems to be especially susceptible to spontaneous combustion, a fact worth remembering when its storage is being considered.

There is no set rule as to the height of coal storage piles. Coal has been successfully stored



Indicator Head of Thornley Coal-Pile Thermometer.

in piles varying from 6 to 60 ft. high. Spontaneous combustion occurs in very low piles, but low piles are preferable since the coal is more fully exposed to the air and in case of fire can more easily be loaded out. The principal disadvantage of high piles lies in the greater difficulty of moving the coal quickly in case of fire. The idea that high piles cause heating at the bottom is erroneous, since as many fires take place at the top of the pile as at the bottom and as many near the outside as near the interior. Indeed, a depth of 5 to 6 ft. seems to be a favorite point for fires to occur.

Ventilation by means of pipes in the coal pile has not proved a success in the United States. The expense of placing and removing the pipes is very high, and unless they are very close together it is doubtful if they are of any special value other than for the purpose of thermometer shafts. In Canada, the Canadian Pacific Railroad has successfully ventilated its coal piles, entirely preventing spontaneous combustion. The method used is that of driving pointed iron rods 1.5 to 2 ins. in diameter vertically down through the pile. After the rod reaches the bottom a bell-shaped collar is slipped over it and forced down about 6 ins. into the coal. The rod is then tapped to pack the coal around it and to loosen the rod, and then both collar and rod are withdrawn. As soon as this is done a rough funnel of tar paper is put on the top of the bell-shaped collar to prevent small pieces of coal falling in or being washed in by the rain. The walls of the hole maintain themselves without protection, ordinarily lasting many months. Holes are usually driven 16 ins. to center. The cost, which is almost wholly labor, amounts to about $0.08 a ton at present prices.

Freshly stored coal should be carefully watched for evidences of heat. Fire will often be made evident by the presence of steam or by gaseous odors. However, it is unwise to depend solely upon visual evidences. Thermometer pipes should be inserted at intervals into the pile. It is impossible to set any critical temperature applicable to all coals in varying storage conditions. One very safe rule is to be ready to remove the coal if the temperature reaches 150 deg. F., and to load it out if the temperature rises to 175 deg. F. After the coal has been loaded out it should be thoroughly cooled before being again placed in storage. It is often desirable to make immediate use of coal that has started to heat, thus saving the double handling resulting from restoring it.

In putting out fires water is an effective agent only if it can be applied in sufficient quantities to entirely extinguish the blaze and to cool all of the heated matter. A small quantity of water is positively dangerous.

It is the practice of the Canadian Pacific Railway Co. always to use water if the fire is a small one, and particularly if it is detected at an incipient stage. The point of high temperature is located by driving test rods into the pile. A pit about 2 ft. deep is then dug right over the center of the trouble, and pointed rods or pipes are driven down into the heated matter. The pit is then filled with water from the hose and kept full, thus quenching the fire at its very center. If the fire is a large one the central pit is used, and in addition a water curtain made by digging a ring ditch about 2 ft. deep with a row of holes in its bottom. The ditch, like the center pit, is kept full of water from the hose, and if there is a tendency for the fire to be driven downward from the center it is put out by the water curtain. This method of putting out a fire is not cheap, but it is quick and results in much less loss of coal than other methods that have been employed.

The heat value of coal is decreased very little by storage. Firemen, however, are almost uni-

TABLE SHOWING RELATION BETWEEN LOCOMOTIVE CRANE TRACK GAGE AND MAXIMUM SWING.

Track gage.	Maximum swing.
4 ft. 8.5 in.	30 ft.
14 ft. 6.0 in.	45 ft.
16 ft.	60 ft.
20 ft.	100 ft.

versally of the opinion that storage coal burns less freely than freshly mined coal. This tendency may be overcome by keeping a thinner bed on the grate and by regulating the draft. The loss in heating values of coal in storage may be taken as 1% for the first week, with a very moderate increase after that period, so that at the end of a year a total loss in the average case will not exceed 3%.

In conclusion, safety in the storage of coal depends upon a careful and thorough consideration of methods and close attention to details. Remember that you will almost inevitably have dangerous fires if you attempt to simply pile coal up without taking thought of your methods and of your means of fighting spontaneous combustion.

Synchronous Motors and Their Industrial Application

Self-Starting Motors Valuable in Many Types of Service—Field Excitation Controls Power-Factor and Armature Current for Given Load—Various Features Involved in Bringing Machine to Speed

By S. H. MORTENSEN

Electrical Engineer, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Development during the last few years through which the self-starting synchronous motor has passed has made this machine suitable for various industrial applications. The main objection to the early self-starting synchronous motor was its low starting torque and the high starting current required to bring such a motor up to synchronous speed, but these handicaps have been greatly reduced in the synchronous motors of modern design.

In construction synchronous motors and alternators are quite similar. Both are of the revolving-field type, and both must be provided with direct-current excitation. Any alternating-current generator will operate as a synchronous motor if provisions are made for starting and bringing it up to synchronous speed. For that purpose the rotor on the self-starting synchronous motor is provided with a squirrel-cage winding, consisting of metal rods imbedded in the pole faces and interconnected with short-circuit rings, giving a construction similar to the one used on squirrel-cage induction motors. With the aid of such a winding the synchronous motor may be started as an induction motor.

When polyphase voltage is applied to the armature terminals of the motor a current will flow in the armature winding and create a rotating field. This field induces currents in the rotor squirrel-cage winding as well as in the rotor poles and spider. A torque will result, and if this torque is large enough the motor will start.

During the starting period the motor field circuit may be left open, or it may be short-circuited through a resistance. The starting torque will be somewhat larger if the field circuit is left open, but a voltage will be induced in the turns of the field coils. If the coils have a large number of turns this induced voltage may be high enough to puncture the field-coil insulation and thus cause a breakdown. The induced voltage is a maximum when the motor starts from rest, and decreases as the motor speed increases until it is zero when the motor reaches synchronous speed. (See Fig. 1.)

In a majority of cases it is found convenient to start the synchronous motor with its field coils short-circuited through a resistance such as the field-discharge resistance or the field rheostat.

Fig. 2 shows the connections for the starting of a motor with open-circuit field, and Fig. 3 shows the connections for starting with the field short-circuited through the field-discharge resistance.

Motors will occasionally be found that will not accelerate much beyond half the synchronous speed when started with the field short-circuited. This phenomenon is caused by the single-phase current flowing in the field circuit, which does not disappear until synchronism is attained. This "sticking" tendency can be overcome either by placing sufficient resistance in the field circuit or, also, by opening the field circuit entirely, which

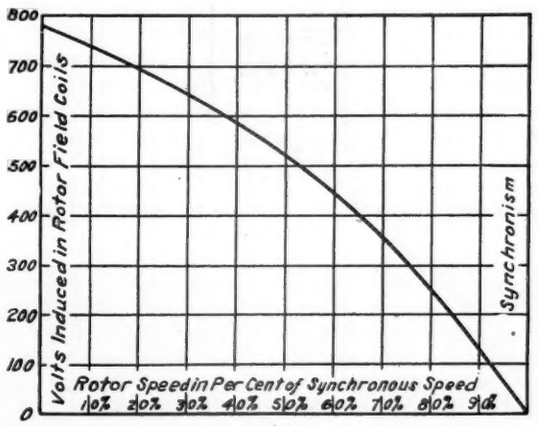


Fig. 1.—Curve Showing Relation of Rotor Speed and Induced Voltage While Starting a Synchronous Motor.

generally can be done without endangering the field insulation after the rotor has reached half synchronous speed. (See Fig. 1.)

As the motor approaches synchronous speed, or the pull-in point, one of the following conditions may arise:

(a) The motor reaches synchronous speed and pulls into step on reduced voltage.

(b) The motor approaches synchronous speed on reduced voltage, but does not lock into step. Direct-current excitation is applied and the motor pulls into step.

(c) The motor runs on reduced voltage, excited but not in synchronism. By increasing the starting voltage the motor locks into step.

As these three assumptions cover some of the most common occurrences in the starting of the synchronous motor, a short discussion of each will be given.

Conditions Where a Motor Comes Up to Speed on Reduced Voltage.

(a) If the motor is running self excited at synchronous speed and d-c. excitation is applied there is an even chance that the field poles and the armature poles will be in phase, in which case the application of the proper excitation will not cause any line disturbances. But if the rotor poles and

armature pole happen to oppose each other, the rotor will slip a pole, thus bringing the armature and field excitation into phase. The slipping of a pole will cause the motor to draw a heavy current during the time of slip. After the motor is excited full line voltage is applied by throwing the motor switch from the starting to the running

Fig. 2.—Connections for Starting Motor With Field Open-Circuited.

position. To reduce the line disturbance to a minimum during this period the switching should be done quickly, and the motor-field excitation should be properly adjusted. The motor is disconnected from the power supply during the period that elapses between the opening of the starting switch and the closing of the running switch, and will drop behind the armature field, and if sufficient time elapses to make the resulting lag appreciable it will cause line disturbances as will be shown later.

Conditions Where a Motor Approaches Synchronous Speed on Reduced Voltage.

The importance of the proper field excitation may be seen from the *V* curves shown in Fig. 4. These *V* curves give the relation between armature current and field current in a synchronous motor for partial and full line voltage. From these curves it is apparent that for *A* ampere excitation the motor draws a leading current of 23 amperes from the line when partial voltage is connected to the motor terminals. For the same excitation with full line voltage applied the motor current is likewise 23 amperes, but the current is lagging. Thus, for *A* amperes field excitation the motor may be thrown from the starting to the running position without any perceptible line disturbance. If instead of *A* amperes the excitation had corresponded to *B* amperes, the line current would have been 7 amperes on partial voltage, but would have increased to 54 when full voltage was applied. This example demonstrates the necessity of the over excitation of the motor fields before full line voltage is applied if the line current is to be kept a minimum for conditions as assumed under case *a*.

After the motor has thus been connected to the line its field excitation may be adjusted for any desired motor current, be it lagging or leading or 100% power-factor.

(b) It has been found that the application of d-c. excitation enables a synchronous motor to pull a considerably higher load into synchronism than is the case before excitation is applied. A weak field excitation is often sufficient to lock the motor into synchronism. After the motor is pulled into step the conditions are similar to those already discussed under (a), and the procedure there described is repeated. It is usually considered of advantage in reducing the maximum starting current to use two starting voltages instead of one. For example, a machine is started on 50% tap and brought into step, then 75% voltage is applied and finally full voltage, instead of applying full voltage immediately after the 50% tap. Experience, however, indicates that with the proper field excitation applied it is possible to throw the motor from 50% voltage to 100% with as little line disturbance as if the 75% tap was used.

This, of course, only holds if the motor actually can be pulled into step on the reduced voltage tap. If that is not the case condition as assumed under (c) arises.

Conditions Where a Motor Comes Up to Speed by Increasing Starting Voltage.

(c) In some cases the motor reaches approximately synchronous speed, but the application of d-c. excitation does not pull it into step. This condition may arise if the external load on the motor is high, say 50% or more of full-load motor torque.

Assume that the motor is started with 60% of normal voltage applied and reaches close to syn-

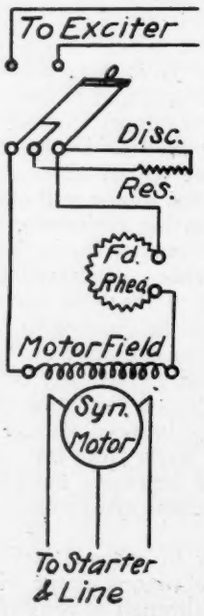


Fig. 3.—Connections for Starting Motor With Field Short-Circuited.

chronous speed, after which excitation is applied. This, however, fails to increase the torque sufficiently to lock the motor into step. The only way to further increase the motor torque then is by

increasing the motor voltage, often to full line voltage, and the motor is then pulled into step.

Heavy loads can be synchronized in this manner, but it will be found that the motor will draw a heavy instantaneous current under these conditions—from four to 10 times full-load motor current, depending upon the inherent characteristics of the machine. Experiments have shown that

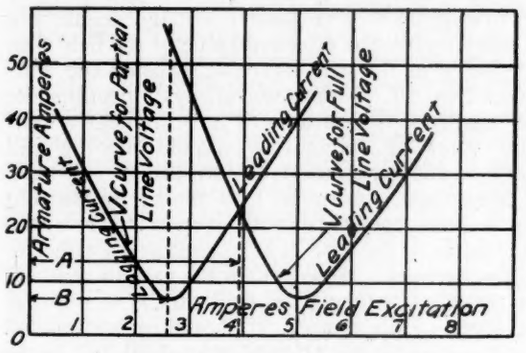


Fig. 4.—V Curves Showing Relation Between Armature Current and Field Excitation.

the starting current drawn by the motor depends upon its field excitation, and in most cases it will be found that a weak field excitation is more favorable than a heavy excitation. The most favorable condition is obtained if at the moment the full voltage is applied the field poles and armature poles happen to be in phase. It would be possible to reduce the instantaneous current rush by placing a reactance in series with the armature winding when the voltage is increased.

In general, it may be said that self-starting synchronous motors of the proper design are able to start and pull into synchronism loads requiring up to approximately full-load torque. Under conditions as described under (a) a motor may synchronize loads from 15 to 20% of full-load

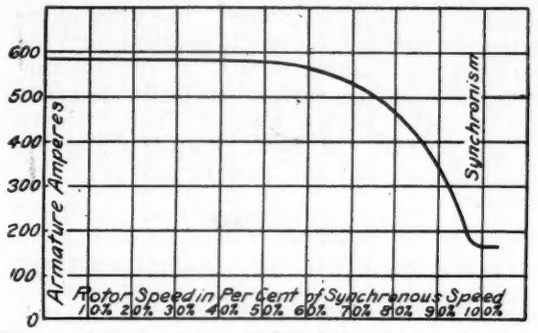


Fig. 5.—Relation Between Rotor Speed and Armature Current During Starting.

torque without the starting current exceeding 110% full-load line current. Under conditions as assumed under (b) loads requiring up to 40% torque may be pulled into step without the starting current exceeding 140% full-load line current.

And, finally, as already stated under (c), it is possible to pull loads requiring approximately full-load torque into step with a properly designed motor. This, however, is only feasible if the sys-

Fig. 6.—500-Hp., 2200-Volt, 180-R.P.M. Synchronous Motor Driving Allis-Chalmers Compeb Mill in Plant of Bessemer Limestone & Manufacturing Co.

tem to which the motor is connected is of such capacity that the motor starting current does not cause any appreciable voltage drop at the motor terminals. The motor starting current increases in proportion to the applied voltage. The torque developed, however, increases in proportion to the square of the applied voltage. Thus the doubling of the starting voltage increases the resulting motor torque four times. The value of the starting current remains nearly constant until the motor reaches from 50 to 60% of synchronism. From there on the current gradually decreases until the pull-in point is reached. This is shown in Fig. 5 where the motor starting current is plotted against the rotor speed in percent of synchronism.

(To be continued.)

CONNECTION OF COMMUTATING POLES AND THEIR EFFECT.

Voltage Characteristic of Generator and Speed Characteristics of Motor Influenced by Interpole Windings.

By E. W. SCHILLING.

Commutating poles are small poles introduced between the main poles of a motor or generator for the purpose of bettering commutation. Unlike the main poles their winding consists of a few turns of heavy wire which carries load current. It is not the purpose of this article to explain the theory of their operation, but rather to give a practical discussion of the many factors which are affected by their use.

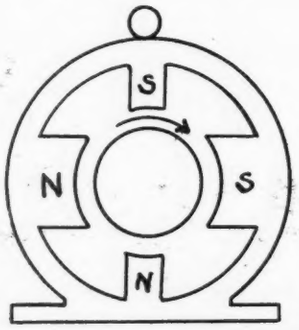


Fig. 1.—Diagram Showing Polarity of Commutating Poles on a Generator.

Under normal conditions it should not be necessary to shift the brushes of a machine from their neutral position in order to secure good commutation. However, there are cases where sparking can be reduced considerably by a slight brush shift. Commutation can usually be bettered on a motor by shifting the brushes backward with respect to rotation, and forward with respect to rotation with a generator. Since a shift of brushes has certain effects upon the operating characteristics of a machine it will be well to study these effects.

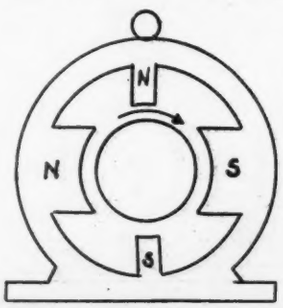


Fig. 2.—Diagram Showing Polarity of Commutating Poles on a Motor.

In the case of a generator a forward shift of the brushes will give poorer voltage regulation. In other words, the effective value of the field flux is lessened as the load increases, causing the voltage to drop off. This is not always objectionable, but usually it is desirable to have as near a constant value of voltage as possible for the full range of the generator from no-load to full-load. Commutation is bettered in a motor by shifting the brushes backward with respect to rotation, but just as in the case of a generator the effective flux is reduced. However, in the case of a motor the result of reducing the field flux is to increase the speed of the motor. It should be understood that the speed is not affected at no-load, but as the load comes on the speed does not drop off as rapidly as it otherwise would. The field may even be weakened enough to cause the motor to have a rising speed characteristic, the speed increasing with the load. This is an undesirable characteristic and the brushes should never be shifted enough to give it.

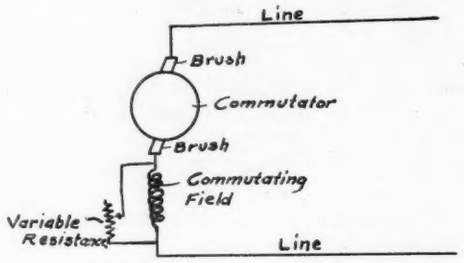


Fig. 3.—Diagram Showing Use of a Shunt on Commutating-Pole Winding.

RELATIONS EXISTING BETWEEN MAIN POLES AND INTERPOLES.

The interpoles must have a certain definite polarity with respect to the main poles. In a generator the pole on the side of the main pole in the direction of rotation should be of the opposite polarity from the main pole itself. This is illustrated in Fig. 1. In a motor the polarity of the interpole should be just the opposite to what it is in a generator. This is automatically taken care of when a machine which has been running as a motor is run as a generator. (See Fig. 2.) It occasionally happens that a motor just received from the factory, or an old motor just back from the repair shop, has its interpoles reversed. The effect of such a connection will usually be to cause the motor to arc-over while it is being started. If a generator has its interpoles reversed commutation will be bad at no-load, and if any appreciable load is put on the result will be the same as in the motor, namely, the machine will arc-over at the commutator. A simple test of the polarity can be made by the use of a compass. The poles should show polarity as indicated in Fig. 1 for a generator and as in Fig. 2 for a motor.

In designing d-c. machines the manufacturer usually figures on a little more winding on the

interpoles than will be needed, and as a result the machine will have too strong a commutating field. The effect is to give the machine a rising voltage characteristic if it is a generator, or speed characteristic in case it is a motor. It may also cause sparking. The interpole field may be weakened by shunting a portion of the current from it in the same manner that an ordinary series field is shunted. This is done by connecting a variable resistance as shown in Fig. 3. A portion of the armature current will then pass through the shunt and the current through the commutating-pole winding will be reduced. This resistance should be varied until sparking is reduced to a minimum and the machine has the proper voltage or speed regulation. In cases where the load is rapidly fluctuating an ordinary noninductive shunt would not be satisfactory. It should be made of such a material and in such a manner that it will offer a high resistance to a sudden change of current value. A shunt is made inductive by winding it on an iron core. The ratio of the shunt reactance to the interpole reactance should be equal to the ratio of the shunt resistance to that of the interpole winding. This may be tested by applying an alternating voltage to the terminals of the shunt and reading the current and then applying the same voltage to the interpole field and reading the current there. The ratio of these two readings will be the inverse ratio of the reactances.

It is often necessary to parallel commutating-pole generators either with similar machines or with machines of slightly different characteristics. In order to do this successfully the machine should not have a rising voltage characteristic. If the generator is shunt wound the voltage should drop off slightly as the load is increased. If it does not do this a slight brush shift in the direction of rotation will usually remedy the trouble. A compound-wound machine should be so designed that without the use of the series winding the voltage would drop off slightly with increase of load.

MARINE RULES PREPARED BY A. I. E. E. COMMITTEE.

Recommended Practice for Electrical Installations on Shipboard—Rules Include Certain Mechanical Signaling Systems.

The difference between the requirements of various classification societies and insurance companies in regard to electrical installations on shipboard and the lack of any accepted standard engineering practice for marine installations led the American Institute of Electrical Engineers in 1913 to appoint a committee on the use of electricity in marine work, now known as the Marine Committee. This committee, besides arranging for papers to be read at the meetings of the Institute to increase the interest of electrical engineers in marine problems, also took up the preparation of the standardization rules which would represent good enginering practice, and which might be accepted by the classification societies. As a result, a set of rules was prepared covering two important divisions, namely, fire protection requirements and marine construction requirements. The first part related primarily to dangers that might arise from fires, and the second part had to do purely with the preservation, maintenance and operation of the electrical plant in its exposure to the conditions existing on shipboard.

These rules were adopted by the Committee of the American Bureau of Shipping and were published as section 37 of the rules for building and classing vessels, issued by that Bureau.

This first edition of the rules did not cover the entire field of the use of electricity on shipboard and the committee was, therefore, continued in force, and a more nearly complete set of marine rules has now been prepared. The committee has made a careful comparison of the rules issued by the American Bureau of Shipping, the National Board of Fire Underwriters, the Steam Boat Inspection Service of the U. S. Department of Commerce, Lloyd's Register of Shipping, the Institution of Electrical Engineers, Bureau Veritas, Germanischer Lloyd and Verband Deutscher Elektrotechniker. With several of these associations, correspondence and personal conferences were carried on.

When the committee had nearly completed its work on the second set of marine rules, the Regulations for the Electrical Equipment of Ships, First Edition, were issued by the Institution of Electrical Engineers in England. These rules have substantially the same scope as those prepared by the American committee, and as there will be some occasion for comparing the engineering practices of the two countries, a slight rearrangement of material has been made to conform more nearly to the order of subjects as given in the English rules, in order to facilitate comparison.

In the preparation of these rules, consideration has been given to the danger from fire, and to durability and reliability of the electrical apparatus itself, but no attempt has been made to divide the rules into separate sections of that character. Certain mechanical signaling systems are included, as it is the custom of many shipyard electrical engineers to supervise the installation of mechanical signaling equipments as well as the electric plant.

The membership of the committee being drawn from a large variety of shipbuilding, manufacturing and engineering interests, including the U. S. Navy, it is thought that the rules, as prepared, represent the best practice for this class of work. During the war a large number of the newer shipyards were represented on the Marine Committee, which gave opportunity for advising them through the committee meetings concerning the best engineering practice as followed by the older yards.

To insure a careful consideration of these rules subcommittees were appointed to cover various branches of the work and after each subcommittee had considered its own rules they were submitted for discussion to the entire committee, after which they were referred to an editing committee of four members to arrange them in suitable form for publication. It is not to be expected that this edition of the rules contains everything that might be of value relating to electrical installations on shipboard, and it is expected that later editions will be prepared which will be more complete and will include electric propulsion.

In the meantime any questions concerning rules which appear to be of doubtful meaning may be referred to the chairman of the Marine Commit-

tee of the American Institute of Electrical Engineers, 33 West 39th street, New York City, and the committee invites suggestions for improvements or amplifications of these rules.

No definite arrangements have yet been made for the approval of apparatus and accessories, but it is expected that through the co-operation of the Underwriters' Laboratories arrangements will be made later by which apparatus or appliances used on shipboard may be inspected and approved. In the absence of approved standards for merchant ships, appliances approved by the Navy Department will in general be satisfactory. Bound copies of the rules may be obtained at $1 per copy by addressing the American Institute of Electrical Engineers, 33 West 39th street, New York City.

FUEL AND HYDROELECTRIC ENERGY AFFECT NAVY.

Permanent Base for Fleet to Be Influenced by Supply of Oil Without Hampering the Industrial Power Supply.

That the Navy is making a survey of the fuel-oil situation on the Pacific coast, preliminary to the final determination as to whether the combined fleets of the United States shall be placed on the Pacific, became known when the bureau of economics made public telegraphic advices received from its Washington representative. The Washington report follows:

"It is known that the California oil situation will have an important bearing on the Navy department's decision as to the final location of the fleet. Oil, of course, can be had in sufficient quantities for the fleet, but the question is, how much will the supplying of the entire Navy with California oil disturb the western industrial supply?

"At the office of Senator Samuel M. Shortridge it was said that the question will probably be put up to the Federal Power Commission to see if the demands of the west coast industry for fuel oil cannot be lightened by the development of more hydroelectric energy.

" 'The question of the oil supply for the Navy in the Pacific is not only one of the present, but of the succeeding 5 or even 10 years,' said Senator Shortridge. 'It is the future that the authorities are interested in, and I understand surveys are being made with the idea of determining just how much fuel oil can be saved by providing western industry with more hydroelectric power.

" 'By conserving fuel oil for use of the Navy and for purposes where hydroelectric power can not be utilized, this Government can provide cheaper power for industrial plants and at the same time insure ample fuel for the boilers of the Navy. The need of acquiring a good-sized quantity of fuel oil in storage is not being overlooked, either.'

"Indications in Washington are that three-fourths of the Navy, and probably more, will be concentrated in the Pacific. This will mean the immediate construction of additional Navy supply stations and repair yards on the Pacific coast, as recommended to Congress by the various Navy boards.

"The battle between the two Navy factions, one of which has all along opposed dividing the fleet, and the other sanctioning the Daniels' order creating a Pacific and an Atlantic fleet, apparently has been won by the faction demanding one great fleet and that it be maintained in one group."

EXPERIMENTAL LABORATORY TO BE BUILT BY WESTINGHOUSE.

Owing to the trend toward higher voltages which is being initiated in the West, and which will ultimately extend to all parts of the United States, the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., is building a complete, modern, high-voltage, experimental laboratory. In this laboratory will be installed two transformers, one rated at 1,000,000 volts, 1000 kv-a., the other rated at 500,000 volts, 500 kv-a. They can be connected together and 1,500,000 volts can be obtained between terminals. This will allow voltages for flashover testing as high as 1,500,000 volts.

The laboratory will be 120 by 110 by 50 ft., without columns of any sort. High-voltage insulators, transformer terminals and circuit-breaker terminals will be tested in this plant.

UTILITY HAS RIGHT TO ENFORCE SERVICE RULES.

The Public Service Commission of Pennsylvania has issued an order directing the Honesdale Consolidated Light, Heat & Power Co. to resume the service of a local consumer, following a controversy over a bill rendered for service. In connection with the order, the Commission says:

"Public utility companies have the undoubted right of enforcing rules for discontinuing service to patrons whose misuse or abuse of service imposes a hardship upon either the utility or its general patrons. Obviously, it is the duty of a utility to protect itself and its ratepayers against dishonest practices or individuals who avail themselves of service without payment therefor. But a charge of misdemeanor, such as involved in the present case, is too serious to be sustained without clear and satisfactory proof."

DUTY OF COMMISSION TO PROTECT PUBLIC.

Col. Frank L. Smith, Dwight, Ill., chairman of the Illinois Public Utilities Commission, in his first official statement since accepting appointment by Gov. Len Small, said: "As I conceive it, this Commission is the protector of the public. Its duty is to get for the people who pay the bills the best possible service at the lowest possible price. Therefore I hope and I am sure those associated with me hope substantial reductions may be brought about at an early date. Speaking for myself, and I think for my fellow commissioners, it seems to me that the fundamental attitude of the commission should be fairness, fair treatment of and consideration for the employes of these companies and above all fair prices and justice for the public."

Fostered because necessary, public utilities have emerged almost overnight, as the most astounding social reality of the past 50 years.

EDITORIAL COMMENT

A Victory for Wasters

The "navigable stream" theory of the pork-rollers and wasters, which has already cost this country untold billions, was again upheld on April 11 by a decision of the United States Supreme Court so far-fetched and rank that it is incomprehensible to a man of ordinary intelligence. Briefly stated, it prevents the Economy Light and Power Co. of Chicago from building a power dam over the Desplaines river near Joliet, Ill. The United States Supreme Court, affirming the decisions of the lower federal courts, decided that the Desplaines river is a navigable stream, within the meanings of the act of 1899, and that the Economy Light and Power Co. has no authority to construct the proposed dam.

The court's decision that the river is navigable was based largely upon the fact that the stream in its natural state had been navigated by early French explorers and later by fur traders and settlers in canoes, batteaux and other light craft. The fact that it is not now navigated does not take it out of the category of streams, across which Congress, by the act of 1899, forbade the building of dams without specific authority of the federal government. The Supreme Court states:

"We concur in the opinion of the Circuit Court of Appeals that a river having actual navigable capacity in its natural state, and capable of carrying commerce among the states, is within the power of Congress to preserve for purposes of future transportation, even though it be not at present used for such commerce and be incapable of such use according to present methods, either by reason of changed conditions or because of artificial obstruction.

"And we agree that the provisions of section 9 of the act of 1899 apply to such a stream. The act in terms applies to 'any navigable river or other navigable water of the United States,' and without doing violence to its manifest purpose we cannot limit its prohibition to such navigable waters as were at the time of its passage or are now actually open for use.

"The Desplaines river, after being of practical service as a highway of commerce for a century and a half, fell into disuse, partly through changes in the course of trade or methods of navigation or changes in its own condition, partly as a result of artificial obstructions.

"In consequence, it has been out of use for 100 years, but 100 years is a brief space in the life of a nation; improvements in the methods of water transportation or increased cost in other methods of transportation may restore the usefulness of this stream.

"Since it is a natural interstate waterway it is within the power of Congress to improve it at the public expense, and it is not difficult to believe that many other streams are in a like condition and require only the exertion of federal control to make them again important avenues of commerce among the states."

The writer of this editorial learned to swim in a pool of the Desplaines river and knows every foot of its sickly, tortuous stream. That it can ever be made a navigable channel in the true sense of that term is almost as remote from possibility as a journey to the moon. This decision, therefore, emphasizes the need of a clarification of the laws of the United States with respect to streams, navigable or actually unnavigable, which will conserve our natural resources, rather than wild-eyed theory, and permit the use of "white coal" in all places where it can be properly and economically effected.

Increasing Rates and Dividends

We believe the action of the Board of Directors of the American Telephone & Telegraph Co. in deciding to increase the dividend rate is justified and commendable. Telephone investment must be made reasonably attractive or this greatly needed utility cannot maintain its service abreast of the public demand. It was a courageous thing for the Board to do and at the same time ask for an increase of rates in the important New York district. The men who did it had the proper vision of the telephone service of the future. The American public desires telephone service and appreciates the best that can be given and we are convinced is willing to pay a reasonable and proper rental and at the same time provide for growth and development.

On another page of this issue is presented an account of some of the important work that is being done in expanding the telephone service in newer fields.

Co-operation in the Industry

Although conditions are not the same as in Great Britain *Electrical Industries* of London, finds suggestive value to its readers in the action of electrical manufacturers in the United States in co-operating with the "supply undertakings"

to promote electrical business. Manufacturers are finding it necessary to curtail expenses wherever expedient, but they are taking broad and long views and are now prosecuting a judicious propaganda campaign. They have appropriated advertising space valued in excess of a quarter of a million dollars to create friendly customers for the electric light and power companies. The campaign is being directed by the National Electric Light Association, and a committee of manufacturers has set before itself the ambitious object of securing from the manufacturers pledges for one-twelfth of their 1921 contracted advertising space. Although it has been working only a short time, the committee appears to have met with a very gratifying response. All kinds of mediums are being utilized to convey the advertisement story—national magazines, the technical press, newspapers, folders, and so on, and needless to say the advertisements, according to the British journal mentioned, "are of that skillful and effective character for which the Americans are famed." As a background for the advertising by the manufacturers, the N. E. L. A. is running through the year in a popular magazine of widespread circulation, a series of thirteen half-pages in which the public is taken into the confidence of the electric supply interest and made to understand sympathetically the unconscious reliance that the individual places on it. Large poster reproductions of the N. E. L. A. advertising are being made upon heavy paper for use by electric light and power companies in their windows. Co-operation, also, has been pledged and is being manifest from the publishers both of general magazines and of the technical press, who appreciate the fundamental relation of the electric supply undertakings to the everyday life of the public. In addition to publication advertising some of the manufacturers are going one step further and are educating their employes through house-organs so that they may favorably influence electric service. Still another form of co-operation in this movement is the insertion of good-will messages in the packages containing goods to be sent out.

The cumulative effect of all this intelligent and well-organized advertising must naturally produce extremely fruitful results. On the financial side it is being undertaken on no niggardly scale. Mr. George F. Oxley, under whose direction the campaign is being conducted from N. E. L. A. headquarters, has estimated that the total value of autumn advertising space, both local and national, used in this effort, will approximate a million dollars. A series of reproductions of advertisements that have appeared in magazines, newspapers and the technical press are typical of the broad-minded enthusiasm with which the electrical manufacturers are helping the electric light and power companies to build good-will. The activities altogether promise to promote a better understanding on the part of the general public of the problems of the electric light and power supply undertakings. While it is true that all concerned in this propaganda campaign will benefit proportionately to its success, care has been taken by those who are conducting it to impress on everybody that in the last analysis it is the public that will have the most lasting benefit through the greater and better service that will accrue.

The above comments, given in the words of our British contemporary, will be of interest to American and Canadian readers as showing how the great good-will campaign of the National Electric Light Association is viewed across the Atlantic.

Education in Industry

The old story of the "talents" and their use has its parallel in the world of industry. The Western Electric Co. has so organized its educational program that it now attempts to meet the needs of all its 30,000 employes. The company believes that it pays to help employes to learn the best methods. When the groups of workers to be trained are large enough full-time instructors are employed to supervise the training. In addition every executive acts to the best of his ability as a coach for his people.

The program provides training for all classes of employes from office boy up. In shaping its courses the company recognizes three fundamental principles—the necessity for close association between instruction and the requirements of workers as workers; the educational value of the daily job—learning through doing, and the importance of promotions, whenever possible, from within the company.

Employes are prepared for their work, for transfer and for advancement in several ways. Job instruction, apprenticeship and expert technical and executive training are given on company time, with pay; general educational courses related to the business for which there is sometimes a small enrollment fee are offered in the evening.

The organization for training follows departmental lines. Since the company has three divisions—engineering, manufacturing and distributing—there is an educational director and staff for each one. There is also an advisory committee on employment and education, composed of these departmental representatives, which meets frequently to discuss principles and policies and to secure uniformity of practice throughout the system wherever it is desirable. Instructors work under the supervision of educational directors. The latter are specialists in demonstration and "all-round men" with trade experience. The edu-

cational system also includes class rooms, facilities for round table discussions and special instruction shops. In addition, there are libraries, the employes' magazine, bulletins and numerous committees to investigate important problems.

Job instruction is given to men and women who are learning specialized operations. The employe is assigned to a teacher who prepares him for his work as easily and quickly as possible. Generally he learns on actual production where he can have the satisfaction of seeing the daily increase in his credit ticket. The instructor watches him, determines whether he is fitted for his position and reports his progress. The training lasts from one day to a month, according to the nature of the work and the aptitude of the employe. Instruction in the installation department is typical where a permanent school is set up. Every man passes through it in a 10-day training and trying-out period. He then spends 8 months in the field and finally returns to the school to attend classes in electrical theory and telephone practice.

The course for office boys is another example of the company's method. At Hawthorne 150 office boys are all placed under the supervision of a man who gives his whole time to the task of their training. For a period of 2 weeks they are sent with experienced boys over a dozen different routes among the buildings which go to make up the plant. After they have learned the geography of the plant they are put to work on simple duties in a private office and are gradually instructed in courtesy, deportment, answering the telephone and filing papers. Those who enter at the age of 16 may, if they wish, take special reading and studying courses and become tool-making apprentices the following year.

More detailed training is given to employes who hold responsible mechanical and commercial positions. There are courses for typists—a 3-months' full-time instruction period for clerks, an accounting course that lasts a year and a 40-weeks' production course that prepares for shop commercial work.

The vast influence of the co-ordination of education with the practical every day business of earning one's living can probably be best appreciated by the individuals of somewhat mature years who are given the opportunity of lifting themselves above and out of their old limitations. But appreciation of the full effects of such a system as that established by the Western Electric Co. is not entirely essential to its success, although the best results can be accomplished only when each individual devotes his earnest attention to the work and strives to rise to the utmost limits of his capacity. Many workers holding positions of small importance, limited because of failure to take advantage of early educational advantages, will be able to make better employes, better citizens and happier men of themselves because of the establishment of this comprehensive scheme of education.

Regulating Utilities

Campbell Russell, chairman of the Oklahoma Corporation Commission, gave a happy illustration of public utilities and their relation to the people in an address before the Lion's Club of Oklahoma City a short time ago. His remarks are quoted as being, in part, substantially as follows:

"Oklahoma's public utilities are like a team of horses. The corporation commission is the stable boy. When you come out and say, let's see the team, we don't want to drive out a pair of high-hipped, slab-sided, wheezy, wind-broken skates and say 'here's the team,' and, when you remark that the nags are not in very good condition to stand a hard drive, have the commission pull out a big basket of corn, representing money saved by reducing rates, and say to you, 'Yes, but look at the feed we've saved you.'"

The core of Chairman Russell's talk was that the people of a community should inform themselves concerning the facts dealing with an increase in rates for gas, water, light, power or transportation before bellowing at the corporation commission for attempting to do justice to the people and at the same time permit a corporation to make a fair return on invested capital.

Chairman Russell stated Oklahoma spent last year $150,000,000 for public-utility service. He said the amount every citizen paid for gas, electricity, telephone and street-car service last year was twice what each paid for all ad valorem taxes, city, county and state, and he thought the relation of the individual to public utilities should be accordingly an educated, intelligent relation.

No starved horse ever pulled a heavy load.

If the water company or the light company in your town is asking for an increase in rates and the claim is that that increase is necessary to keep the plant alive, it is your first duty to see what merit there is in their case and oppose it only if the demand is an unjustifiable one.

The above remarks, taken in substance from the editorial columns of *The Daily Oklahoman*, seem to indicate that both the regulating authorities and the *Press* in Oklahoma are awake to the importance of utilities to the prosperity of the public. If every state or regulatory district could boast of a fair and diligent supervising body and an equally fair and diligent *Press*, seeking to inform the public of its actual need of the utilities and of the importance of properly supporting its utilities, then the public-utility problem would be practically solved.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

A. I. E. E. SECTION MEETINGS TO BE HELD THIS MONTH.

The Chicago section of the American Institute of Electrical Engineers will hold a joint meeting April 25 with the electrical and mining section of the Western Society of Engineers and the Association of Iron and Steel Electrical Engineers. Papers will be presented on "Diversity Factor of Coal-Mining Loads," by Carl Lee, E. E. Peabody Coal Co., and "Power Distribution Systems for Coal Mines," by W. C. Adams, Allen & Garcia Co. Both papers will be illustrated with lantern slides.

"Engineering Education" will be the subject discussed by Prof. Comfort A. Adams at the April 22 meeting of the New York section of the A. I. E. E., which will meet in joint session with the Metropolitan section of the American Society of Mechanical Engineers in the auditorium of the Engineering Societies building, 33 West 39th street, New York City.

The 307th meeting of the A. I. E. E. will be held in New York City, May 20. This will be the annual meeting of the Institute, at which the results of the annual elections and the report of the Board of Directors will be announced. A technical program will follow the business session.

N. E. L. A. CONVENTION ARRANGEMENTS BEING PREPARED.

General Convention Committee Announced and Cards Prepared to Organize Hotel and Transportation Accommodations.

This year the annual convention of the N. E. L. A. will be held at the Hotel Drake, Chicago, May 31 to June 3 inclusive. The convention proper will have four general sessions on Tuesday, Wednesday, Thursday and Friday—May 31 and June 1, 2 and 3. These general sessions will begin at 9:30 a. m. and will adjourn daily at about 1 o'clock. Prominent speakers already have been arranged for to address each of the general morning sessions. In addition there will be the Public Policy Night and meetings of the four national sections—Accounting, Commercial, Public Relations and Technical—running in parallel sessions during the afternoon. It is expected that there will be between 40 and 50 reports, which will cover the activities of the sections and of the national special committees, as well as the subcommittee activities.

The Drake is a new hotel, situated at the head of the famous Lake Shore drive and within a few blocks of the theater and shopping district of the city. Its location is ideal for convention purposes, as it is away from the noise and dirt of the city and combines all of the pleasures of an attractive summer resort with the comforts of a luxurious metropolitan hotel. Spacious lobbies and several large and small meeting rooms promise convention facilities fully adequate to the occasion. The hotel is a 14-story structure modeled after the Italian Renaissance style. There are 800 guest rooms, many of which overlook the beach and the waters of Lake Michigan, 100 yards away.

Personnel of General Convention Committee.

The personnel of the general convention committee that is arranging for transportation, hotel accommodations, entertainment and the like is as follows:

E. W. Lloyd, chairman, Commonwealth Edison Co., Chicago; H. E. Niesz, chairman entertainment committee, Commonwealth Edison Co., Chicago; G. A. Freeman, chairman subcommittee of entertainment committee on local transportation, Walker Vehicle Co., Chicago; F. R. Jenkins, chairman hotel committee, Commonwealth Edison Co., Chicago; O. R. Hogue, chairman registration committee, Commonwealth Edison Co., Chicago; G. H. Atkin, master of transportation, Electric Storage Battery Co., Chicago; Charles B. Burleigh, Boston district, General Electric Co., Boston; Clarence L. Law, New York district, The New York Edison Co., New York City; Howard K. Mohr, Philadelphia district, The Philadelphia Electric Co., Philadelphia, and W. L. Abbott, chairman local industries committee, Commonwealth Edison Co., Chicago.

Members at Large.—H. E. Addenbrooke, Commonwealth Edison Co.; C. E. Allen, Westinghouse Electric and Manufacturing Co.; E. H. Cheney, Wagner Electric Manufacturing Co.; H. V. Coffy, H. M. Byllesby and Co.; W. H. Coleman, General Electric Co.; G. E. Cullinan, Western Electric Co.; E. J. Doyle, Commonwealth Edison Co.; E. A. Edkins, Commonwealth Edison Co.; G. B. Foster, Commonwealth Edison Co.; D. H. Howard, Commonwealth Edison Co.; G. A. Hughes, Edison Electric Appliance Co.; G. H. Jones, Commonwealth Edison Co.; W. S. Kline, Commonwealth Edison Co.; J. G. Learned, Public Service Co. of Northern Illinois; W. W. Low, Electric Appliance Co.; W. C. Lounsbury, president, Great Lakes Division, N. E. L. A.; R. V. Prather, secretary-treasurer, Great Lakes Division, N. E. L. A.; W. H. Ott, Commonwealth Edison Co., and Marshall E. Sampsell, Middle West Utilities Co.

Fred R. Jenkins, chairman of the hotel committee, is now sending to all members of the Association a circular describing the hotel accommodations and requesting members to make their hotel reservations by filling out and sending in the card which is inclosed with the circular.

Godfrey H. Atkin, master of transportation, is sending out a card asking members to signify whether they expect to attend the convention. It

is important that these cards be filled in and returned to Mr. Atkin promptly so that transportation arrangements can be carried out. The Association hopes to secure a round-trip fare of one and a half times the one-way fare. There will be special trains from some cities and special cars from others.

The general convention circular with registration cards for members and guests inclosed will be sent out in a week or 10 days. This circular will probably contain a tentative convention program.

"LIGHTING ABROAD" DISCUSSED BY CLEVELAND ENGINEERS.

The Cleveland chapter of the Illuminating Engineering Society held its second regular meeting April 7, and was very fortunate to have as the speaker J. E. Randall, consulting engineer of the National Lamp Works of General Electric Co., who spoke on the subject of "Lighting Abroad." Among other things, Mr. Randall discussed the lighting of theatres, hotels, stores, streets, and railway trains in England, France, and Germany. In the matter of sign-lighting he stated that there was nothing abroad which compared with such lighting as the "great white way" in New York, and that he felt that the latter was worth going a long way to see. At the close of the discussion following the reading of the paper a demonstration of show-window lighting was made in a model show window set up in the rooms of the Electrical League. Some beautiful color effects were shown.

REVIEW OF BUILDING OPERATIONS SHOWS PROGRESS.

Large Amount of Work Under Way and in Prospect, Shows Conditions to Be Greatly Improved.

Building activities are the key to expansion in the electrical industry. If building were to cease completely it would be only a matter of a short time until all expansion in electrical activities would stop and the entire industry would become stagnant. But with building activities on the increase, the electrical men of the country are assured of a steady field of activity. The central station is assured of more load, the contractor has more construction work to do and the dealer has a new list of prospects wherever building is active. This, of course, passes on a measure of prosperity to the jobber and manufacturer.

With these facts in mind it would appear that the following review of building operations in March, taken from reports of the F. W. Dodge Co., should carry a good measure of cheer to all branches of the electrical industry:

"The figures for building activity in March indicate widespread progress toward resumption of normal activity. Contracts awarded during March in the 25 Northeastern states amounted to $164,194,000, an increase of 63% over the February figure. The increase is largely due to a greatly increased number of small projects. The total number of contracts awarded in March was 78% greater than in the preceding month.

"A comparison of this year's activity with that of last year is not to the point. At this time last year building activity was approaching the crest of a wave; now it is emerging from the trough. The conditions of this year are more nearly like those of 1919. Contracts awarded during the first quarter of this year have numbered 12,180 and have amounted to $376,631,000. During the first quarter of 1919, contracts numbered 10,724, amounting to $274,562,000.

"Among the contracts let in March, 1921, residential projects took the lead, amounting to $60,693,000, or 37% of the total. Public works and utilities amounted to $34,068,000, or 21% of the total; business buildings, $22,776,000, or 14% of the total; educational buildings, $19,030,000, or 11% of the total, and industrial buildings, $10,640,000, or 7% of the total.

"Contemplated new projects were reported in March to the number of 10,184, at an estimated cost of $398,071,000. The very considerable increase in contemplated new work is largely made up of small projects. Gradual resumption through widespread development of small building projects, which is now well under way, is an indication of a wholesome resumption of normal activity in building, which should be followed by resumption of normal business conditions in general.

New England.—"Contracts awarded in the New England states in March amounted to $13,262,000, an increase of 84% over the February figure. Comparing the first quarter of 1921 with the first quarter of 1919 (when conditions were very similar to those of this year) the following figures are noted: Contracts awarded in the first quarter of 1921 amounted to $28,574,000; in the first quarter of 1919, $22,220,000.

"March, 1921, figures included: $4,675,000, or 35%, for residential buildings; $2,343,000, or 18%, for business buildings; $2,010,000, or 15%, for social and recreational buildings, and $1,782,000, or 13%, for public works and utilities.

"Contemplated new work reported in this district during the first three months of the year has amounted to $120,731,000, more than four times the amount of work started. Public works and utilities predominate among the contemplated projects, with residential projects in second place. If the labor troubles which have been recently reported in this territory can be satisfactorily and speedily settled, building activity should proceed at a gratifying rate.

New York and Northern New Jersey.—"In New York State and Northern New Jersey, March building contracts amounted to $29,846,000, an increase of 40% over the February figure. The increase in the number of building projects started was 63%. The total contracts awarded during the first quarter of 1921 have amounted to $72,622,000. During the first quarter of 1919 (when conditions most nearly resembled those of the present year) contracts were let to the amount of $49,208,000.

"March, 1921, figures included: $17,679,000, or 59%, for residential buildings; $4,570,000, or 15%, for business buildings; $2,370,000, or 8%, for social and recreational buildings, and $1,822,000, or 6%, for educational buildings.

"Contemplated new work reported in this district during the first three months of the year has amounted to $402,324,000. Even though this

includes one enormous project (a $200,000,000 bridge reported in February) which will take a long time to develop, the great bulk of small projects contemplated is significant. If this one large project be omitted, residential work predominates among the remaining contemplated projects. The outlook for a continued increase in general activity, and especially for residential work, in this district is distinctly encouraging.

Middle Atlantic States.—"Contracts let during March in Eastern Pennsylvania, Southern New Jersey, Delaware, Maryland, District of Columbia and Virginia amounted to $27,069,000, an increase of 65% over the February figure. The number of projects started in March was 75% greater than in February. The total contracts awarded during the first quarter of 1921 have amounted to $57,403,000, compared with $47,632,000, for the first quarter of 1919 (a time when, like the present, building activity was emerging from a period of depression). The principal items among the March, 1921, awards were: $10,635,000, or 39%, for residential buildings; $6,826,000, or 25%, for public works and utilities, and $4,671,000, or 17%, for business buildings.

"Contemplated new work reported for this district from Jan. 1 to April 1 has amounted to $185,902,000, about four times the amount of work started, an indication of the increased activity to be expected during the coming months.

Pittsburgh District.—"Contracts awarded during March in Western Pennsylvania, West Virginia, Ohio, Kentucky and Tennessee amounted to $37,871,000, an increase of 87% over the February total. During the first quarter of this year contracts awarded in this district amounted to $85,869,000, a very substantial gain over first quarter of 1919 (when conditions were similar to those of this year).

"March contracts included the following: $12,581,000, or 33%, for residential buildings; $11,737,000, or 31%, for public works and utilities; $5,316,000, or 14%, for educational buildings, and $3,805,000, or 10%, for business buildings. Contemplated new work has been reported in this territory during the first three months of the year to the amount of $149,855,000, residential work leading all the other classes of buildings.

Central West.—"March building contracts in the Central West (including Illinois, Iowa, Indiana, Wisconsin, Michigan, Missouri and portions of Eastern Kansas and Nebraska) amounted to $48,513,000, an increase of 49% over the February figure. The total number of projects in March was 74% greater than in February. Contracts awarded during the first quarter of 1921 have amounted to $116,937,000, which was somewhat greater than the figure for the first quarter of 1919. Comparisons between these two years are significant, on account of the prevalence of similar business conditions.

"Included in the March total were the following: $13,147,000, or 27%, for residential buildings; $9,723,000, or 20% for public works and utilities; $9,132,000, or 19%, for educational buildings; $6,570,000, or 13%, for business buildings, and $4,832,000, or 10%, for industrial buildings. Contemplated new work to the amount of $381,143,000 has been reported in this district during the first quarter of the year.

Northwest.—"March building contracts in Minnesota and North and South Dakota, amounted to $7,632,000, an increase of 152% over the February figure. The total number of projects started in March was 378, compared with 138 in February. During the first quarter of 1921, contracts awarded amounted to $15,225,000, compared with $4,772,000 for the first quarter of 1919, when conditions were similar to those of this year.

"The March, 1921, total included: $2,542,000, or 33%, for public works and utilities; $1,976,000, or 26%, for residential buildings; $1,011,000, or 13%, for public buildings, and $817,000, or 11%, for business buildings. Contemplated new work reported from Jan. 1 to April 1 has amounted to $62,168,000, or four times the amount of contracts awarded."

SOCIETY FOR TESTING MATERIALS TO MEET IN JUNE.

Specifications for Rubber and Other Insulating Materials to Be Subject of Discussion—Special Consideration Given to Insulated Wire.

The next annual meeting of the American Society for Testing Materials will be held at the New Monterey hotel, Asbury Park, N. J., from June 20 to 24 inclusive. Monday, June 20, will be devoted to committee meetings. The first session of the annual meeting will be on Tuesday morning, June 21, and the closing one on Friday evening, June 24. In about a month a provisional program including announcement of entertainment features will be sent to the members.

From present indications the meeting in June will be the largest the society has ever held. Probably in no other year have committee activities been greater, and a number of interesting and important reports are in prospect. Separate sessions will be devoted to several important subjects. One on petroleum products will be introduced by the report of committee D-2 and will include papers on the refining of petroleum, the description of novel apparatus used in the testing of petroleum products, and on gasoline. Another session will be devoted to road materials and in addition to the report of the committee on that subject will include papers on the composition of slags suitable for concrete, the measurement of impact, determination of percentage of asphalt to use in soil-asphalt mixtures, and tests of soil for use in subgrades. Still another session will be devoted to cement and concrete, for which several valuable papers have been secured. A number of timely papers on iron, steel and non-ferrous metals are also scheduled for presentation, as well as several dealing with subjects of importance to the paint industry.

The committee on electrical insulating material has held two meetings already this year. It is expected that this committee will complete work which will permit the presentation to the society in June of new tests for insulating varnishes, transformer oils and porcelain. A large amount of work has been done during the current year on all of these subjects, particularly transformer oils. In connection with the latter the results of experimental work done during the last three or four

years by four different laboratories have been carefully analyzed and the conclusions utilized in the preparation of the specifications. It is expected to include these data in the annual report of the committee.

The committee on rubber products has been very active during the year, having held three meetings since the last annual meeting. Most of its work has consisted in revising a majority of the specifications which had previously been issued by the committee. The fire and air hose and belting specifications are being extensively revised and will be submitted at the June meeting, together with a revision of the tentative insulated wire and cable specifications.

A new specification for rubber gloves for electrical workers will be proposed this year. A specification for rubber insulating tape is now under discussion.

ELECTRIC HEATING SHOW PLANNED IN NEW YORK CITY.

The various exhibits held during the past few months in the showrooms of the New York Edison Co. at Irving place and 15th street, New York City, have proved so successful that it is now planned to exhibit electric heating devices from June 6-11.

Cartridge units, tubular units, soldering irons, capping tools and branding irons and apparatus for candy making, printing plants and other industries will be shown and demonstrated. This will be the first time that such an exhibit has been presented and practically every electrical appliance for industrial heating that has been perfected during the past 5 or 10 years will be displayed. Forty odd manufacturers have signified their intention of taking part and probably a hundred different applications of electric heat will be on view. The space is free to exhibitors and no admission will be charged the public.

ANNUAL PRODUCTS SHOW STAGED BY WESTERN ELECTRIC CO.

The day of the human cog in industry is nearing its end. Instead of resting content to have their workers lead dull lives, ignorant of the real meaning of the great bustle of which they form a part, the more progressive manufacturers are taking steps to acquaint their personnel with the why and the wherefore of everything they do. The annual products show staged by the Western Electric Co. at its big plant near Chicago, is a fitting example of this big educational step in industry. Every type of machinery used in the factory, and every little item produced in it are displayed, in pieces, partially assembled, and assembled and explained by demonstrators. Thousands of employes visit the show with their families, and department heads conduct their own workers through it.

The big electrical concern is anxious to develop active inquiring brains in its employes. With more than 20,000 workers engaged in more or less specialized work at Hawthorne and spread out through more than 75 acres of buildings it is obvious that very few individuals in the course of their work have a chance to get a knowledge of the plant as a whole. Ordinarily they would have but a faint idea of the real duties of the men on either side of their own work benches. To offset this condition the company arranges an exhibit of all its processes, wares and instruments each year. For 3 days and nights it is open to the workers. They are not only enabled to see just how their own individual efforts affect the finished product but they also get an opportunity to learn what uses are made of all the appliances.

A. E. S. WILL DISCUSS CORROSION PROBLEMS.

The forthcoming meeting of the American Electrochemical Society, to be held at Atlantic City, N. J., April 21-23, promises to be one of unusual interest. One feature of the technical program will be a symposium of corrosion. The fact that the corrosion problem is receiving wide consideration is manifested by the numerous papers contributed to this symposium. That iron rusts has been common knowledge for centuries, and many of the factors which control its rate of corrosion have been understood for some 20 yrs.; nevertheless, rust-eaten iron and steel work is an all too common sight—all because more iron and steel can be obtained to replace that corroded. The situation is not an excusable one since the cost of replacing steel work is often far in advance of the cost of the material itself. Some types of non-ferrous corrosion will also be brought up for discussion and the arrangements for the program necessitated extending the symposium over nearly two morning sesions. This symposium should throw some new light on this problem, as well as brighten the future outlook for anti-corrosion.

The corrosion symposium will be succeeded by the presentation and discussion of papers on experiments and more recent developments along electrochemical and electrometallurgical lines. An innovation at this meeting will take the form of competitive sports and recreations, extended plans for which have been made. The social events arranged for include golf, trap or rifle shooting, billiards, chess, yachting, dancing and theater going.

LYNN SECTION, A. I. E. E., HOLDS MUSICAL EVENING.

The Lynn (Mass.) Section of the American Institute of Electrical Engineers observed "Guests' and Ladies' Night" April 6, and enjoyed a musical evening in the auditorium of the Lynn Classical High School. John B. Taylor, consulting engineer of the lighting department, General Electric Co., Schenectady, N. Y., spoke on the subject of "Instruments of the Orchestra." An orchestra composed exclusively of General Electric employes was gotten up and demonstrated the descriptions of the speaker in an interesting and entertaining way. The lecturer explained why and how sounds are produced on orchestral instruments, which together with lantern slides and vocal demonstration by means of a great variety of instruments produced a unique lecture.

An inspection trip was made April 9 by members of the section to the United States Arsenal at Watertown, Mass.

U. S. CHAMBER OF COMMERCE WILL MEET THIS MONTH.

The general theme of the ninth annual meeting of the Chamber of Commerce of the United States, to be held at Atlantic City, April 27-29, will be: "In the public interest more business methods in government; less government management of business." All of the questions to be brought before the meeting will be approached as they relate to the general subject. Speakers will include government officials and leading business men in many lines of finance, commerce and industry.

Much of the work of the convention will be done as heretofore in group sessions. Groups representing the major divisions of business will take up, first, problems peculiar to the industries or interests within the group, and second, major problems common to all business, which will include the question of the tariff and that of taxation.

DISCUSS TRANSMISSION PROBLEMS AT N. E. L. A. MEETING.

The Public Service Section of the National Electric Light Association held in Chicago last month its first meeting of the year. The program included illustrated papers by F. E. Goodnow and Alfred Herz, the former giving a general outline of the development of the transmission system of the Public Service Co. of Northern Illinois, and also some of the operation difficulties experienced with the growth of the system.

Mr. Herz dealt with the changing of the 33,000-volt transmission system of the south zone from delta to grounded star connection. A general outline was given of the advantage and disadvantage of the star and delta systems for transmission, together with a general description of the work necessary to effect this change in the company's system.

EARNINGS OF ALLIS-CHALMERS CO. SHOW INCREASE.

The 1920 report of the Allis-Chalmers Manufacturing Co., Milwaukee, shows earnings of $9.35 a share for the common stock as compared with less than $7 in 1919. Very significant was the fact that the profits of the last quarter were above the average—amounting to $2.91—while unfilled orders at the close of the year were over $17,000,000, against $16,000,000 at the end of the previous year. This showed, what has been common to the makers of electrical equipment, that their earnings and volume of business generally did not suffer at all from the slump toward the close of 1920, that they earned more rather than less during the last 3 mos. of the year than they had earned on the average for the previous quarter.

STATIONARY ENGINEERS TO MEET.

The 26th annual convention of the New York State Association, National Association of Stationary Engineers, will be held June 9-11 at New York City, with headquarters in the Hotel McAlpin, 34th street and Broadway.

COMING CONVENTIONS.

Kansas City Electrical Show. First annual electrical exposition, Convention Hall, Kansas City, Mo., April 18-23. Manager, Sam Furst, Electrical Trades Exposition Co., 802 Broadway, Kansas City, Mo.

American Electrochemical Society. Spring meeting, Atlantic City, N. J., April 21-23. Headquarters, Hotel Chalfonte. Secretary, Joseph W. Richards, Lehigh University, Bethlehem, Pa.

Missouri Association of Public Utilities. Annual convention, Kansas City, Mo., April 21-23. Secretary, F. D. Beardslee, 315 North 12th street, Chicago.

Wisconsin State Association of Electrical Contractors and Dealers. Spring meeting, Appleton, Wis., April 22. Secretary, H. M. Northrup, 23 Erie street, Milwaukee.

American Washing Machine Manufacturers' Association. Meeting at Sherman Hotel, Chicago, May 18-19. Secretary, Enoch B. Seitz, Otis building, Chicago.

Southwestern Electrical and Gas Association. Annual convention, Galveston, Tex., May 18-21. Headquarters, Hotel Galvez. Secretary, H. S. Cooper, 409 Slaughter building, Dallas, Tex.

American Society of Mechanical Engineers. Spring meeting, Chicago, May 23-26. Headquarters, Congress Hotel. Assistant secretary, C. E. Davies, 29 West 39th street, New York City.

International Railway Fuel Association. Annual convention, Chicago, May 24-26. Headquarters, Hotel Sherman. Secretary, J. G. Crawford, 702 East 51st street, Chicago.

Stoker Manufacturers Association. Annual meeting, Stockbridge, Mass., May 24-26. Headquarters, Red Lion Inn. Chairman of Publicity Committee, R. C. Beadle, 11 Broadway, New York City.

Electrical Supply Jobbers' Association. Thirteenth annual meeting, Hot Springs, Va., May 25-27. Headquarters, The Homestead. General secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Pacific Coast Geographic Division of the National Electric Light Association. Annual convention, Del Monte, Cal., May 25-27. Headquarters, Hotel Del Monte. Secretary, L. H. Newbert, 445 Sutter street, San Francisco.

National Electrical Light Association. Annual convention, Chicago, May 31-June 3. Headquarters, Drake Hotel. Executive manager, M. H. Aylesworth, 29 West 39th street, New York City.

Tri-State Water and Light Association. Annual convention, Asheville, N. C., June 15-16. Secretary, W. F. Steiglitz, Columbia, S. C.

National Fire Protection Association. Annual convention, San Francisco, June 14-16. Secretary, Franklin H. Wentworth, 87 Milk street, Boston.

Canadian Electrical Association. Annual convention, Quebec City, June 15-17. Secretary, Eugene Vinet, Power building, Montreal, Que.

American Institute of Electrical Engineers. Annual convention jointly with the Pacific Coast convention. Salt Lake City, Utah, June 20-25. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

North Central Geographic Division of the National Electric Light Association. Next convention, Duluth, Minn., June 21-23. Headquarters, Spaulding Hotel. Secretary, H. E. Young, 15 South Fifth street, Minneapolis, Minn.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 12-15. Headquarters, Breaker's Hotel. Secretary, D. L. Gaskill, Greenville, O.

National Association of Electrical Contractors and Dealers, Anniversary convention, Buffalo, N. Y., July 20. Secretary, W. H. Morton, 110 West 40th street, New York City.

Illuminating Engineering Society. Annual convention, Rochester, N. Y., Sept. 26-30. General secretary, Clarence L. Law, 29 West 39th street, New York City.

New York Electrical Show, 71st Regiment Armory, Park avenue and 34th street, New York City, Sept. 28-Oct. 8. Manager, Norman Maul, 130 East 15th street, New York City.

COMMERCIAL PRACTICE

New Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

SUCCESS OF CUSTOMER-OWNERSHIP PLAN DEMONSTRATED.

Since the Pacific Gas & Electric Co., San Francisco, about 6.5 yrs. ago, first put into practical operation what has subsequently become widely known and adopted as the "Customer Ownership" plan, it has in the period from June 3, 1914, to Jan. 31, 1921, made 12,194 direct sales of its first preferred stock for an aggregate par value of $20,126,450. The following tabulation shows the sales in each year to customers, employes and others:

	No. of sales.	Par value.
1914	3,739	$ 8,801,300
1915	1,712	3,785,100
1916	617	1,123,100
1917	650	890,000
1918	192	156,000
1919	53	45,900
1920	3,670	3,634,650
1921 (to Jan. 31)	1,561	1,690,400
Total	12,194	$20,126,450

It seems probable that, judging from the continuing demand for this stock, the present issue of $5,000,000, which was authorized by the California Railroad Commission some months ago, will soon be exhausted.

EMPLOYES MAY AID IN FORMING OF PUBLIC OPINION.

Pamphlet Suggests Ways in Which Public Utility Employes May Promote Good Relations by Personal Contact With Public.

By JAMES LIGHTBODY,
British Columbia Electric Railway Co., Ltd., Vancouver, B. C.

Every business to be successful must have pleasant relations with its customers. Failing that, customers go elsewhere. Big organizations like public-utility companies are no exception to the rule. Even more than storekeepers must they see that their thousands of tiny transactions every day are accompanied by the maximum amount of good will. For these customers, composing entire communities, have it in their power to make or mar us. To an extent not approached by any other business, public utilities progress according as they possess the good will of the public. The essential nature of our business to community life has taken it out of the realm of a private business. Today the public, either through their representatives or through their direct powers, control the public utilities. Yet, while the public is possessed of great powers over its public utilities, certain sections of the public are still in ignorance of some of the simplest facts about these utilities and this ignorance, if allowed to continue uncorrected, may do damage to our business and their service.

Relationships between public-utility companies and public are improving fast all over this continent. The prejudices of a few years ago are giving way to enlightenment and broadmindedness. But where there still exist bad relations and strife, it can be traced down inevitably to ignorance on the part of the public. Were ours a private business we could have little concern about the ignorance of the public concerning our problems for they would pay to overcome such problems in higher prices. But public utilities must have an understanding public before they can charge higher rates. As the public are virtually the employers who pay the wages, the relationship between employe and public becomes a most direct and personal one, for as the public is educated to a public utility company's problems and assists it accordingly, so the employe benefits.

The employes of this company, therefore, are potential builders of good will for the B. C. Electric. As employes of the company they have a duty in this regard in addition to their specific routine work. As employes of the public they have a duty to promote the good will of the company so that the company may enjoy fair returns and thus pay fair wages, and a duty to give their employers, the public, good and courteous service. The object of this pamphlet is to suggest ways in which employes may promote good relations between company and public through their innumerable contacts with the public, through their associations and clubs and through their friends.

The man on the street thinks in terms of every day service. He uses the street cars, the electric light or gas, speaks to the conductors, talks to our employes over the telephone or counter, or in some way seeks or gets our service. In the giving of service employes have it in their power to make friends for the company. The thousands of contact points every day can be occasions for the injection of the serum of good will. A soft answer turneth away wrath. A smile, a helping hand to a woman or child getting on a car, an attentive ear to a question over the counter—all these little details make friends for the company. These are the things which make it possible for the company to obtain rate increases, just as much as the most logical economic arguments.

Each employe who comes in contact with the public, and many who do not, are potential ambassadors of friendship. Platform men, meter readers, sales agents, ticket agents, cashiers, elevator and telephone operators, delivery men and every one who meets the public at a desk or speaks to it over the telephone are all messengers of good will. Traffic inspectors, car cleaners, barn men, substation operators, trouble men, gas employes, despatchers and janitors, though a step removed, can, through their duties, make the company's service well thought of. Every one of our 2800 employes can count at least a score of close personal friends—persons to whom he or she can talk candidly and openly.

If each of our employes were to win over to active support of the company only ten of his friends a year, it would not be many years before a great portion of the community would be wholly sympathetic towards the B. C. Electric.

Disseminating Good Will Through Personal Contact of Employes.

This is no idle dream. It can be done. There are today hundreds and even thousands of persons in British Columbia not connected with the B. C. Electric who are boosters of the public-utility companies in their own self-interest. No other channel can be half as effective for disseminating good will than the personal contact of our employes. Let us see how we can go about it.

We suggest that you incorporate in your mind the company's general aim, namely, to give the best possible service at the lowest possible rates. Financially, the company asks only such return on its investment as will attract new capital to it. A fair and reasonable return and no more is what we ask. We want to give good service. We court full and frank criticism of our service and we are ready at all times to receive suggestions for its improvement. The only limitations to our service are those imposed by lack of capital and what is good business. For example, it would not be policy for any company to construct a street car line a mile in length to accommodate a dozen residents, nor a light and power line costing $10,000 to get a monthly revenue of $1 a month.

If we are to impress anyone with the importance of public utilities we must be impressed ourselves. We have nothing to be ashamed of as a public-utility company. There is nothing yet which will replace electric traction. Electric power and light are only beginning their progress. We are conducting a legitimate business and an essential business. We have nothing to apologize for. We are giving good service and we have every right to ask a fair return.

It is not sufficient that we merely give good service, be courteous and make friends, necessary as these qualities are. We must take active steps to dispel ignorance and prejudice from the minds of the public by continually stating the true facts about our business. We have a distinct duty to let the public know the real nature of our business. They have been fed for years upon misstatements and it is only by the dissemination of the truth that their sentiment is changing to one of friendship.

In the limits of this pamphlet, it is not possible to recite all the facts about the public-utility business which employes may relay to their friends. We suggest that in order to be fully equipped, you read the current technical magazines to be found in the company clubs and that you study the company's publicity matter. Briefly summarized, here are the main points which it is well to keep in mind:

Public-utility service is essential to the welfare of the community. It is not a private business but is regulated and controlled by franchises, commissions and public opinion. The company and the public are, therefore, partners, and anything which injures the company or prevents it from performing its services indirectly injures the public.

Public-utility service must expand with the needs of the community or the community will stop progressing. New capital for street cars, electric power plants, distribution lines, gas plants and mains must be forthcoming as our district grows, otherwise all business will cease to expand. New capital requires a fair return on the investment, which requires fair rates for service.

Enlightening the Public on Quality of Service Performed.

The public is largely ignorant of the plant and organization which lies behind the street car, electric light and power and gas service. You should be in a position to talk intelligently on some one or other phase of the company's business. The public should know what millions of dollars are tied up in power plants which are called into use only a few hours a day and a few months a year.

Let the public know that electricity cannot be stored up like gas; how duplicate transmission lines, transformers, oil switches and other apparatus must be maintained to prevent the cessation of service for a minute; how a steam plant is kept in readiness with steam practically up to take the place in part of the hydroelectric plants in case of a breakdown; how all these things go to make up the quality of service which the B. C. Electric stands for; and how, in view of all these items which the public never notices or realizes, B. C. Electric service is the cheapest commodity they can get today.

Read up on such questions as municipal ownership, franchises, regulation of public utilities and public utility investments. Be in a position to talk intelligently to someone who attacks the company on one or other of these questions. Point out, for example, that public utilities give service at cost, namely, for the cost of operation and a fair return on the investment; that municipally-owned utilities have to meet just the same costs but suffer the mismanagement of political control; that franchises nowadays must be framed to protect the utility as well as the public, otherwise there can be no expansion.

From time to time, you will be met with criticisms of the company's service. They may be good humored criticisms. They will mostly be particular complaints—that is, only a small proportion will be general complaints about the company's service or actions. The company takes pains to accept all complaints and criticism with the best of grace and we suggest that our employes do the same.

To employes in the more responsible positions we suggest that you take an active part in public and semi-public organizations. It is of great benefit that the business men of the district know you personally because it gives the company an identity. The company would like to have all its employes talking about "our company." Without being a bore, you should boost for your company and for its management whenever you can. Tell people what the company does for its employes. Describe some of the up-to-date methods it employs. Give people the impression that the company knows its business so that they will respect it.

The general effect of your getting behind the company will be very beneficial. For the public to know that there is a body of employes heartily

supporting the company will have an effect which cannot be obtained by any amount of propaganda. If the employes act as a body in support of the company in time of need people will take heed. The public can understand people but it can't always understand a complex organization like a corporation. They—and incidentally the politicians—will pay far more attention to the voices of 2800 employes who live, buy, work, play and vote in this district.

Do not think these details we have mentioned are not worth while. Good public relations are not obtained in a day, nor by one action. They are the result of years of painstaking effort by everyone in the organization. They result from thousands of little details of service, courtesy and education.

In spite of the best publicity organization in the world, a company may lose all it has gained in years by some little inexcusable failure to give service. So we must store up for a rainy day the most favorable public opinion possible, because no matter how perfect our service, there will come times when public opinion will be taxed to the utmost.

MONTHLY PUBLICATION ISSUED BY UTILITY EMPLOYES.

"Fumes and Flashes" is the title of a monthly publication issued by and for the employes of the Western States Gas & Electric Co., Stockton, Richmond and Eureka (Cal.) divisions. This is the third publication of the kind issued by employes of the Standard Gas & Electric Co. subsidiaries, the first being the "Oklahoma Meter" of the Oklahoma Gas & Electric Co., Oklahoma City, and the second "Sparks and Flashes" of the Oklahoma Gas & Electric Co., Enid, Okla.

The Western States Gas & Electric Co. recently moved into a new building constructed specially for its occupancy at the corner of Channel and Sutter streets, Stockton, Cal.

SERVICE DEPARTMENT CREATED BY OKLAHOMA UTILITY.

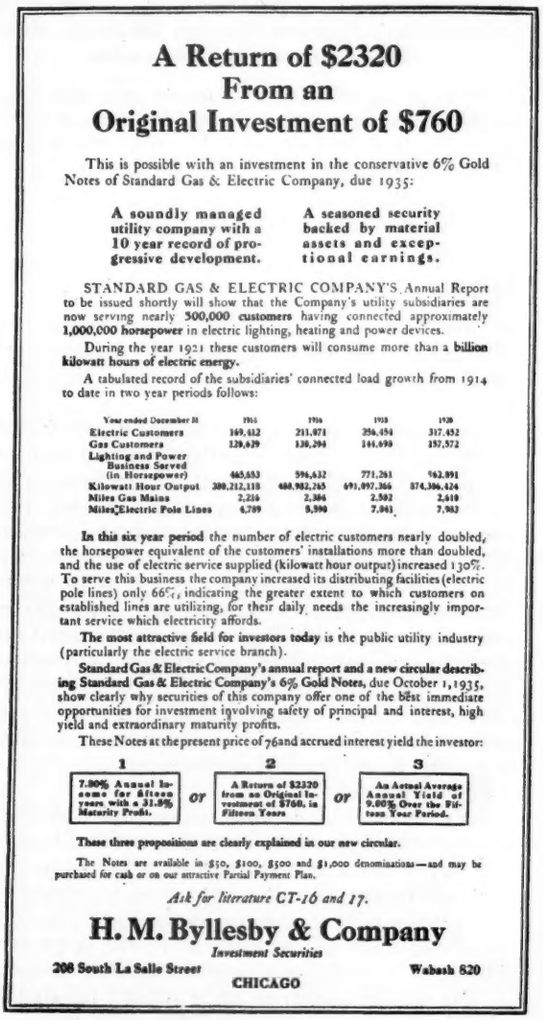
The Consumers Light & Power Co., Ardmore, Okla., has organized a service department, the purpose of which is to enable the company and the consumers to get together in the most efficient spirit of co-operation possible with a view of settling complaints and any other differences which may arise in a rapid and correct manner to the satisfaction of all concerned. The department will be in charge of Tate G. Glenn as service manager.

ATTRACTING INVESTORS' INTEREST BY LOCAL ADVERTISING.

Standard Gas & Electric Co. Sells Large Amount of Gold Notes Through "Humanized" Type of Financial Advertising.

During March the utility subsidiaries of the Standard Gas & Electric Co. co-operating in the customer-ownership plan sold a total of $769,500 par value of preferred stocks of the several companies to their customers. This makes a total of $1,972,300 worth of stock so placed by these companies in the first 3 mo. of 1921. In addition to this $124,200 of notes of two of the companies were placed locally, making a grand total of $2,096,500 of securities placed locally by the Standard's subsidiaries in the first quarter of the year.

In line with this plan and in order to attract the interest of investors, H. M. Byllesby & Co., which controls the Standard Gas & Electric Co., utilized the advertising columns of a Chicago newspaper recently, which resulted in the sale of a large amount of the 6% gold notes of the Standard Gas & Electric Co. In commenting on this the Byllesby



A Return of $2320
From an
Original Investment of $760

This is possible with an investment in the conservative 6% Gold Notes of Standard Gas & Electric Company, due 1935:

A soundly managed utility company with a 10 year record of progressive development.

A seasoned security backed by material assets and exceptional earnings.

STANDARD GAS & ELECTRIC COMPANY'S Annual Report to be issued shortly will show that the Company's utility subsidiaries are now serving nearly **500,000 customers** having connected approximately **1,000,000 horsepower** in electric lighting, heating and power devices.

During the year 1921 these customers will consume more than a **billion kilowatt hours of electric energy.**

A tabulated record of the subsidiaries' connected load growth from 1914 to date in two year periods follows:

Year ended December 31	1914	1916	1918	1920
Electric Customers	169,412	211,071	256,494	317,452
Gas Customers	129,629	138,294	144,699	157,572
Lighting and Power Business Served (in Horsepower)	465,653	596,632	771,261	962,891
Kilowatt Hour Output	300,212,110	488,982,765	691,097,306	874,306,426
Miles Gas Mains	2,216	2,306	2,502	2,610
Miles Electric Pole Lines	6,789	8,390	7,943	7,983

In this six year period the number of electric customers nearly doubled, the horsepower equivalent of the customers' installations more than doubled, and the use of electric service supplied (kilowatt hour output) increased 130%. To serve this business the company increased its distributing facilities (electric pole lines) only 66%, indicating the greater extent to which customers on established lines are utilizing, for their daily needs the increasingly important service which electricity affords.

The most attractive field for investors today is the public utility industry (particularly the electric service branch).

Standard Gas & Electric Company's annual report and a new circular describing Standard Gas & Electric Company's 6% Gold Notes, due October 1, 1935, show clearly why securities of this company offer one of the best immediate opportunities for investment involving safety of principal and interest, high yield and extraordinary maturity profits.

These Notes at the present price of 76 and accrued interest yield the investor:

1 — 7.90% Annual Income for fifteen years with a 31.8% Maturity Profit. — OR

2 — A Return of $2320 from an Original Investment of $760, in Fifteen Years — OR

3 — An Actual Average Annual Yield of 9.00% Over the Fifteen Year Period.

These three propositions are clearly explained in our new circular.

The Notes are available in $50, $100, $500 and $1,000 denominations—and may be purchased for cash or on our attractive Partial Payment Plan.

Ask for literature CT-16 and 17.

H. M. Byllesby & Company
Investment Securities
208 South La Salle Street — Wabash 820
CHICAGO

Reproduction of Advertisement of Standard Gas & Electric Co.

company states that there were two reasons for this success; one is that the advertisement is a "humanized" type of financial advertising, and the other is that the note is an unusually attractive security, netting as it does an actual annual yield of 9%. The remarkable growth of the Standard Gas & Electric Co. and its possibilities for future growth are touched upon in the advertisement and are described more fully in a circular being distributed by the Byllesby organization.

Over 400,000 men and women of voting age of the state now own securities of the electric, gas, electric railway and telephone companies of Illinois.

ELECTRICAL COMMUNICATION

Items of Interest in Connection with Present Practice and Progress in the Science and Art of Transmission of Intelligence by Electrical Means

RADIO MEN TO FORM SECTION OF A. M. OF E. S.

Manufacturers of Radio Apparatus Desire to Improve Their Industry Through Affiliation With Electrical Supplies Association.

As a result of the preliminary and subsequent steps taken by several manufacturers who exhibited at the convention held under the auspices of the Executive Radio Council for the Second District at the Hotel Pennsylvania, New York City, a few weeks ago, their application to form a section of the Associated Manufacturers of Electrical Supplies has been granted and shortly Charles E. Dustin, general secretary of the Association, will send out notices for an organization meeting to take place this month at the association headquarters, 30 East 42nd street, New York City.

At this convention it was disclosed that the radio industry needed stabilization and improvement in the selling methods of radio-apparatus manufacturers, since at present the general policy seems to be to sell to any tradesman—hardware and sporting goods dealers, electrical jobbers and other merchants. After discussion as to whether radio manufacturers should sell only through electrical supply jobbing houses with special radio departments, or direct to retailers, or whether jobbers handling radio apparatus exclusively were justified, it was decided that either a separate radio association should be formed, or affiliation with the Associated Manufacturers of Electrical Supplies sought.

The absence of definite selling and distribution plans for their products was also noticeable among the larger radio manufacturers, while many small manufacturers of radio apparatus admitted little knowledge of accounting methods or labor and overhead costs. Practically all of the large manufacturers of radio products in the East, and many of the smaller concerns, have applied for membership in the new section and the radio industry is assured of being put upon an organized business-like basis.

DEVELOPMENTS AND RESEARCH IN TELEPHONY.

Information Taken From Annual Report of President of American Telephone & Telegraph Co. for 1920.

An extremely interesting and informing annual report was made by Harry Bates Thayer, president of the American Telephone and Telegraph Co., for the calendar year, 1920. The purpose of the extensive report was to make known to the large and increasing body of stockholders the unusual demands for service and the company's broad and progressive plans. The point is well made that the telephone has become a nation-wide utility and must reach across the continent and connect not only large communities, but settlements and farm houses.

Mr. Thayer reviews the organization of the telephone service and its manufacturing side, and describes at length the early yet far-seeing license contract relations set up between the Bell organization and its several associated companies, saying:

"With all of the complications of varying state legislation and supervision it has made possible the operation of the System through scores of companies as a homogeneous whole. It has kept this country constantly far in the lead in the development of the telephonic art. It has saved hundreds of millions in first cost of plant and tens of millions in annual cost of operating, of which the public enjoys the benefit."

The report contains a very complete survey of the work of "development and research" that was carried on by the company during 1920. This department is under the direction of Vice-President John J. Carty, for many years the distinguished chief engineer of the company. This presentation of work accomplished and proposed is given below and is of interest to every reader of the ELECTRICAL REVIEW, as well as the public in general:

The year just closed has been one of remarkable activity in the department of development and research. In this department, including the laboratories at the Western Electric Co., 2800 employes are engaged exclusively in research and the development and improvement of telephone and telegraph apparatus and materials and methods. Of these, 1100 are engineers, chemists, physicists and other scientists, among whom are graduates of more than 100 American colleges and universities. The remainder are laboratory assistants, draftsmen, stenographers, clerks, model makers and administrative personnel.

At the close of the year, upwards of 2500 research and development projects were in hand, all these calculated to improve the service which the associated companies are rendering to the public or to make it more economical.

During the year, hundreds of new patents relating to the telephone and telegraph, issued in various countries, have been examined and studied; the latest discoveries in science have been followed with care by our scientific staff; and over 1000 United States patents relating to telephony and telegraphy have been applied for by, or issued to, or acquired for the use of this company. Not only has attention been given to fundamental improvements in transmission and in apparatus and materials, but minute care and study have been devoted to improvements in the thousands of diversified parts which are required for the most effective and economical operation of the Bell system. In the magnitude of its operations, the number of its personnel and in the size and equipment of its laboratories, this research and development organization far exceeds that maintained by the telephone and telegraph administration of any government or by any other corporation engaged in similar or related work.

During the year, the department has actively continued its work in developing the radio art. Two experimental

radio telephone transmitting and receiving stations have been erected on the Atlantic coast, one near Asbury Park in New Jersey, and the other near Plymouth in Massachusetts. By means of these stations, radio telephone communication has been maintained with two ships experimentally equipped, plying from Boston to southern ports on the Atlantic coast.

Radio telephone communication has been established from Santa Catalina Island, about 30 mi. out in the Pacific Ocean, to the mainland near Los Angeles, and at that point making junction with the local and long-distance wires of the Bell system throughout the United States.

During the International Communications Conference held in December, a demonstration was given at New York for the benefit of the members of the conference, at which time the steamship *Gloucester* on the Atlantic coast communicated by radio telephone through the New Jersey station, and thence by wire across the North American continent to San Francisco and to Los Angeles, and thence by radio telephone to Santa Catalina Island, in the Pacific Ocean. This demonstration was successful and the conversation between the ship in the Atlantic and the island in the Pacific was clearly heard at New York by the members of the conference.

This achievement well exemplifies the special field of radio telephony, which is particularly adapted to use between ship and shore, between ship and ship, between airplanes in flight, between airplanes and ships, and from airplanes to the ground. For such purposes wires cannot be used. In the case of Catalina Island, a cable would carry the traffic from the island to the shore more economically and satisfactorily, but owing to conditions growing out of the war it was impossible to have the cable manufactured as soon as required, so that the radio telephone was installed.

For all such uses, when so-called static disturbances are absent, and when other and interfering stations are not operating, good transmission by the radio telephone can be obtained; but for the above mentioned reasons, and for other causes, radio telephone service is not so dependable and economical as that supplied by wires.

Furthermore, it should be noted that the facilities of the ether for the simultaneous sending of numerous telephone messages are so limited that the ether itself can carry but a small part of the enormous volume of the telephone traffic required by the entire world. The right of way, therefore, must be given to ships, to aircraft, to radio compass stations, and to all other radio stations so situated that wires cannot be employed.

In order to reduce the interference in the ether and to provide the maximum opportunity for communication for mobile and other stations which cannot use wires, the International Communications Conference has proposed a regulation to limit the use of international radio telephony to cases where telephonic communication by any other means is impossible. While this proposed regulation rests on a sound basis and represents the consensus of opinion of the best radio experts in the world, it is, nevertheless, expected as time goes on that a large use of radio telephony will develop in its own special fields. It will play an important part in establishing telephone communication with otherwise inaccessible places, and will make it possible for aircraft in flight and ships at sea to connect with the wires of the Bell system and thus hold conversation with any of its subscribers wherever located throughout the United States. The activities of a section of our development staff, therefore, are being devoted exclusively to wireless telephony.

It will be recalled that in 1915 our engineers, using the wireless telephone system which they devised, transmitted speech across the Atlantic Ocean for the first time in history. In view of this fact and because no means have yet been found for talking across the ocean through submarine cables, it is desirable that development work in this branch of the radio art be continued.

With this in mind, representations were made to the International Communications Conference asking for the allocation of suitable wave lengths for transoceanic telephony. Owing to the limited number of wave lengths available for this purpose and owing to the fact that the radio telephone requires from six to ten times as many wave lengths as are required by telegraphy, the desired number of wave lengths could not be obtained. It is hoped, nevertheless, that, without encroaching unduly upon the limited facilities available for telegraphy, the necessary wave lengths for experimental purposes may be allotted.

For issuing storm warnings to mariners at sea, for broadcasting weather reports and frost warnings to agriculturalists, and for other similar purposes where it is desired to send information broadcast to be picked up simultaneously by any number of receiving stations, the radio telephone has special fields of future usefulness. For these purposes, and for the purpose of sending out calls for help from a ship or aircraft in distress, the fact that the telephone conversation or message can be heard by all who have proper receiving stations is a decided advantage.

On the contrary, however, when the telephone message is intended to be received by only one station, this lack of privacy is a defect, and in the case of radio telegraphy used for press dispatches where it is not intended that the news should be sent broadcast, but rather only to the subscribers of press associations which furnish news exclusively to their subscribers, the advantage of some method of secret communication is a substantial one.

In the transmission of news, speed is an essential factor, and while it is not impossible at the present time to encipher news dispatches by ordinary methods so that only subscribers who have the key can understand them, the time required for enciphering and deciphering makes these methods objectionable. Accordingly, the department of development and research has worked on the problem of applying to radio telegraphy the quick cipher or secret method of wire telegraphy which our engineers developed and which was so successfully used upon wires by the signal corps during the war. This method has been mentioned in a previous annual report. It is a secret means of telegraph communication, and while the message may be heard at all radio stations, it can be interpreted only by those who have been provided with the cipher key and our automatic cipher apparatus. This instantaneously enciphers the message at the sending end and deciphers it at the receiving end, where it appears immediately in printed page form in plain language ready for use.

During the past year our engineers have successfully used this quick ciphering method in radio telegraphy for short distances, so that the messages were received and instantly deciphered at the station for which they were intended, yet they could not be read by any station not in possession of the key to the cipher and the deciphering apparatus. Our work upon this system has developed so satisfactorily that it is hoped that with further improvements in the radio art this secret method of telegraphy can be made available for greater distances and eventually for general employment in radio telegraphy.

The problem of attaining privacy in radio telephone transmission is peculiar and difficult. Nevertheless, in the solution of this problem we have also made important progress. Our engineers have carried on conversation by radio telephony according to a method which they devised whereby ordinary receiving stations can hear nothing but unintelligible sounds; yet at all stations equipped with the necessary special apparatus and in possession of the requisite operating information, the spoken words can be heard and understood. Our development in this direction is being continued.

Because of its peculiar nature, so much space has been required to give an idea of our development work in the radio art that our many important advances in wire transmission must at this time pass with only brief mention. In the last report, mention was made of new methods of improving the transmission over the longest telephone wires. These methods have now been commercially applied to the transcontinental circuits and the predicted results have been completely realized, so that conversation between New York and San Francisco can now be carried on as satisfactorily as between such points as Boston and New York.

Great attention has been given to devising new methods for increasing the carrying power of the toll line plant of the Bell system in respect to the number of telephone and telegraph messages which may be transmitted over one circuit. The multiplex telephone and telegraph system which was developed by our engineers and referred to in the annual report of 1918 has been still further advanced and has been applied on a substantial scale to our plant, with satisfactory results. Our development work in printing-telegraph systems has demonstrated that the printing-telegraph machine has such an important place in the telegraph art that our work upon such apparatus is being continued and has resulted during the year in improvements of great value.

The continued expansion of electrical power and rail-

way systems, and particularly the high-voltage transmission of power, has rendered the problem of avoiding interference with the telephone system one of increasing importance and complexity. Important work in this direction, involving further co-operation with public authorities and electric companies, has been projected and is now in progress.

All parts of the plant—wire, cables, switchboard, substation instruments and all other apparatus affecting telephone and telegraph transmission and service—have been carefully studied, with the result that numerous important improvements have been made. Worthy of special mention are improvements in central-office machine-switchboards, telephone substations, preservation of poles, cables containing increased number of wires, central-office power plants, and new methods for telephoning and telegraphing through long overhead and underground cables.

The company installed a net increase of 563,430 telephone stations during 1920, the largest number ever constructed in one year. The Bell system now has Bell owned and Bell connecting stations numbering 12,601,935, and during 1920 averaged *daily* exchange connections of 31,835,000 and toll connections of 1,327,000 aggregating a *total daily average* of telephone conversations of 33,162,000. In the year the receipts from operating revenues was $449,442,115. The "toy" of a third of a century ago has become one of the commercial wonders and greatest needs of our progressive civilization.

WIRELESS TELEPHONE TO BE USED BY CITY POLICE.

Wireless telephony is to be given a tryout in Chicago's police system. Sending apparatus with four antennae capable, when working in combination, of sending 1000 miles, will be installed on the roof of the City Hall, it is reported.

To begin with, receiving sets will be installed on two fire boats, two lake cribs, two fire engine houses, two police stations, the Englewood fire alarm office, two patrol wagons, and two of the fast automobiles working out of the detective bureau.

Sound amplifiers at the receiving stations will be sufficiently strong to permit the voice at the central station to be heard from 50 to 100 ft. from the horn-shaped receiver, and the voice of the person at headquarters giving information about the latest crime will be heard even above the exhaust and noise of a speeding automobile.

CHINESE SKATERS GET MUSIC OVER TELEPHONE WIRE.

Thanks to the introduction of the latest American developments in telephone amplification, the skaters who have been making the rink of the Peking Club their headquarters this year have been able to perform with a regular jazz accompaniment. C. H. Minor, manager of the China Electric Co., Far Eastern subsidiary of the Western Electric Co., secured for the Chinese rink a loud-speaking apparatus of the same type as that used at President Harding's inauguration. Several amplifying horns were set up about the ceiling of the rink and connected by wires and an amplifying device with a phonograph in the club basement. The effect is more satisfying than the brassiest of brass bands. The Peking Club has a first-class hockey team made up of the best skaters among the foreign element at the Chinese capital.

AGRICULTURAL MARKET REPORTS TO BE SENT BY WIRELESS.

Beginning April 15, agricultural market reports are to be sent daily to farmers and other agricultural interests by wireless from Omaha, St. Louis, Bellefonte, Pa., and Washington, D. C., officials of the Bureau of Markets, United States Department of Agriculture, recently announced.

Wireless stations of the United States Postoffice Department are to be used. Each station has a radius of approximately 300 mi. and farmers located in 12 central and 10 eastern states will be able to obtain, either directly or through local wireless receiving agencies, information relative to prices and conditions at the leading agricultural market centers and shipping points the same day business is transacted. The radio call signal will be "Q. S. T.," which means "call to all stations," or "everybody listen."

More than 65% of the energy measured at the switchboard of the Union Electric Light & Power Co., St. Louis, in 1920 was water power service. Notwithstanding an increase in price of part of the hydroelectric energy, under an adjustment made by the state commission in May, 1920, the company was not subjected to as large an increase in costs of operation as would have been the case had its entire output been steam-generated. The availability of coal supply from the mine of the Union Colliery Co. (the entire capital stock of which is owned by the Union Electric Light & Power Co.) of Duquoin, Ill., enabled the company to overcome the difficulties of deliveries of coal, and secure lower prices than it would otherwise have paid. Higher prices of coal purchased were largely compensated for by automatic adjustments of rates under electric service contracts.

There are 300,000 separate owners of the public-utility securities in Illinois. These companies have 193,000 employes. The estimation that 600,000 others are dependent upon these workers means that probably 800,000 persons in the state are getting their livelihood directly from the work attendant with the production of these services; while another group of employes whose labor is dependent upon the materials and supplies purchased by these companies brings the total number of persons financially interested in public utilities up to 1,500,000. The wages alone of the workers employed in the utility industry amount to more than $230,000,000 annually.

Demands by the public for additional telephone service during 1920 necessitated the installation of the great total of 563,430 additional telephones by the Bell system alone, the largest number of stations ever added in one year, and bringing the number in service up to 12,601,935. The wire mileage of the company now totals 25,377,404—enough to go around the earth at the equator 111 times.

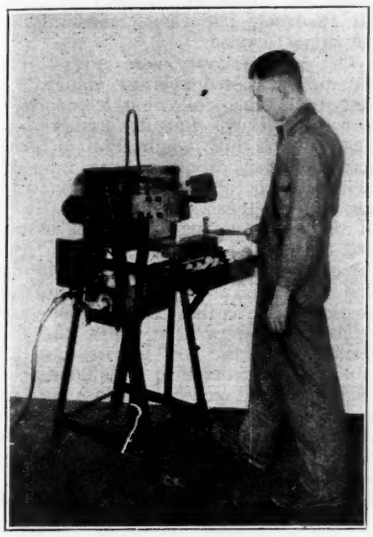
Although the electric light was invented only 40 yrs. ago, today 9,000,000 American homes are lighted by electricity, and industry would be paralyzed were electric plants to close.

APPLIANCES and DEVELOPMENTS

New, Improved or Interesting Electrical and Mechanical Apparatus and Devices, and Applications of Equipment and Methods in Practice

New Type of Rivet Heater for Construction Work.

A new and improved type of rivet heater, suitable for work in shipyards, on building construction, structural steel work, etc., has recently been developed by the General Electric Co. The heater



Rivet Heater Suitable for Ship and Building Construction Work.

is designed to provide entire safety and is adaptable for both intermittent and steady operation. The heater consists of an air-cooled transformer, with a single turn short circuited secondary, in which the rivets to be heated form a part of the secondary circuit. The primary winding is designed for operation on 220, 440 or 550-volt, single-phase circuits of 40, 50 or 60 cycles. Taps are brought out from the primary winding to a drum controller, so that six different voltages can be obtained on the secondary. This makes adjustment for various sizes of rivets, or rates of heating, simply a matter of setting the handle on the drum controller.

The secondary coil is divided into two upper electrodes moved by pedals, and a cold-rolled copper electrode block directly under them. The two rivets to be heated are placed on the lower block, and the movable electrodes lowered on them, thus completing the circuit. Since the resistance of the rivets varies from six to 50 times that of the copper, according to temperature, most of the electrical energy in the secondary is dissipated in the form of heat in the rivets. Accompanying table gives the approximate time in seconds required to heat the rivet. Two rivets are heated at once so that the output of the heater will be two rivets for each unit of time as shown by this table. The tests from which these figures were obtained were run with clean rivets. If rivets are covered with rust or scale, or if the electrode block is dirty, heating will be somewhat slower, because the electrical contact will not be as good.

It often happens, especially in building construction, that the demand for rivets is intermittent, for various reasons. In order to take care of such a condition this heater is provided with a switch which operates to disconnect one side of the primary from the line. The switch is opened by means of a lever convenient to the left hand of the operator.

The main advantages of the electrical method of heating rivets are the absence of fumes and smoke, especially in confined areas and the fact that it is always ready for operation, not requiring any firing up, and when not being used is neither wasting fuel nor burning up rivets. It can be installed anywhere, since no fuel has to be carried to it, or provision made for disposing of the ashes. All adjustments are made without the possibility of coming in contact with live parts, since the control apparatus is totally inclosed.

The heater is rated at 15 kw. at 90% power-factor continuously. The input can be increased to 17.5 kw. for 2 hrs., or 20 kw. for 1 hr. without exceeding the rated temperature rise of 55 deg. C. It weighs about 600 lbs. and is provided with a bail for lifting, or if desired, wheels so that it can be rolled from place to place.

TABLE SHOWING APPROXIMATE TIME IN SECONDS TO HEAT RIVETS.

Length under the head in inches.	Diameter of rivet in inches.							
	¼	⅜	½	⅝	¾	⅞	1	1¼
1-inch	16	10.6	17.6	....	....	...	...	...
2-inch	28	25	24	37	52.4	56	...	...
3-inch	38	38	36	41	60	69	85	100
4-inch	..	46	50	55.6	68	85	94	140
5-inch	..	50	56	72	84	116	132	190

New Product Added to Family of Columbia Goods.

The demand for a dry battery of two cell-power has been met by the National Carbon Co., Inc., Cleveland, with its new Columbia bell ringer, which is of the same moisture-proof construction as the line of Columbia shot batteries manufactured by the same company. This battery, although designed primarily as a bell ringer, has a number of other equally important uses, such as for operating heat regulators, annunciators and buzzers, electrical toys and wireless sets, signal and burglar systems, 3-volt lighting outfits, and any applications where but a light drain is necessary and long life is desirable.

The practicability of the battery is evident in that it lends itself to simple means of installation; a nail or hook of any kind being ample on which to hang the battery, and but two connections are made by the installer. The Columbia bell ringer is 6.75 ins. high, 5-in. wide and weighs 4.75 lbs. Special grade cells are used in this battery. Unlike the ordinary dry cell for general use these cells are similar to the Columbia telephone type of battery, where long life is obtained by virtue of the

Columbia Bell Ringer Battery.

battery's ability to withstand the effects of idle deterioration and operate on light drain circuits.

The National Carbon Co. has made arrangements for selling the bell ringer in a specially selected barrel assortment containing "Hot Shot," "Ignitor" and "Bell Ringer" batteries.

Eveready Batteries Assembled in New Form.

Nine new "special use" dry batteries, ranging from 2 to 15 cells, assembled in single moisture-proof or water-tight jackets with only two terminals to connect, and each battery named and labeled to show the use for which it is designed, are announced by the American Ever Ready Works, Long Island City, N. Y. Recognizing the wisdom of supplying the public with scientific dry-battery advice the manufacturer has spent several months in exhaustive research in this field. Heretofore, the man buying a dry battery has been left largely to his own resources in finding the particular type of battery best suited to his needs. The new products are the Eveready bell ringer, Eveready Ford ignition battery, Eveready gas engine battery, Eveready Ford lighting battery, Eveready tractor battery, Eveready portable lighting battery, Eveready motor-boat battery, Everready lighting and ignition battery and Eveready marine lighting and ignition battery.

The 2-cell Eveready bell ringer is said to be the leader of the line. It is a "package of electricity" in con-

venient form ready to be hung on a rail or hook with its two terminals connected for door bells, enunciators, thermostats and burglar alarms. The Eveready Ford ignition battery and Eveready Ford lighting battery are in four and five coil moisture-proof construction, respectively. The former is designed particularly for starting with crank; the latter for lighting head lights and tail lights while the engine is at rest. The battery labels contain diagrams showing how the batteries may be installed in a Ford car.

The Eveready gas engine battery and Eveready tractor battery have four and five cells, respectively, also in moisture-proof construction, but with the cells in two rows. Either may be used for lighting one 2-cp. lamp with the Eveready portable lighting outfit, and the tractor battery is also adaptable for heavy duty bell, buzzer and annunciator work in large homes, apartment buildings, hotels and offices. The Portable lighting battery has 10 cells in two rows, also in moisture-proof case, and is designed for lighting two 2-cp. lamps in camps, cottages, cellars, closets, garages, and outbuildings.

There are three batteries in watertight cases which make them especially useful in wet places and for all marine work. Eveready motorboat battery, Eveready lighting and ignition battery and Eveready marine lighting and ignition battery have 5, 10 and 15 cells in one, two and three rows, respectively. The label of each battery in the line contains a list of all other uses to which that battery may be put in addition to that suggested by its name. The labels are particularly attractive in design and the goods will look well on the shelves of any dealer.

"Merchandising dry batteries for special uses will apply simplified selling to the dry-battery business," says Emmett Moore, assistant general manager of the American Ever Ready Works. "We shall feature the line in our consumer advertising in national publications, support it with good strong dealer helps, and we fully expect it to meet with the hearty approval of consumers and dealers."

Instrument Determines CO_2 and Detects CO.

Furnace efficiency should be considered separately from boiler efficiency, and the key to the proper testing of furnace efficiency is continuous gas analysis which not only measures the excess air present at all times, but also promptly detects and measures the presence of combustible gases in the flue whenever they appear. When coal is burned in a boiler furnace under ordinary conditions an average of about 65% of the heat generated is used to make steam, 25% goes up the chimney, and the balance is lost through radiation and in the ashes. How important it is to hold the chimney losses down to a minimum becomes evident when we consider that every decrease in chimney losses results in a proportionate saving of heat available for steam making.

To produce steam representing 1000 units of energy, it is necessary, on the 65% efficiency basis above described, to consume approximately 1538 units of energy as it comes in the fuel. Now suppose the chimney losses are reduced from 25 to 15% and that the 10% thus saved is turned into useful energy, making this 75% of that supplied in the fuel. Then, to produce 1000 units of useful energy requires only 1333 units of energy as supplied in the fuel. The difference between 1538 and 1333 is 205, and this is nearly 15.5% of 1333, the fuel actually required to carry the load under the more economical conditions. In other words, the saving in fuel represents 15.5% of what is necessary under the more efficient operating conditions.

Heat is lost up the chimney in two distinct forms, namely, the sensible heat of the entire volume of flue gases, and the heat represented by the chemical energy in unconsumed combustible gases. The amount of the sensible heat is a

Instrument for Determination of CO_2 and Detection of CO.

function of the temperature and the volume of the flue gases. The amount of heat lost in the form of chemical energy is a function of the heat of combustion of the unconsumed combustible gases and their volume. The loss of heat represented by a certain percentage of unburned combustible gases in the chimney is much greater than the loss of heat due to excess air represented by an equivalent percentage of CO_2.

To completely burn fuel a surplus of air is always necessary over what would be theoretically correct. The amount of this surplus varies constantly, depending upon the many different factors that influence combustion. However, maximum efficiency under practical conditions is attained when there is just enough surplus air to make complete combustion possible; that is, combustion without the escape of combustible gases up the stack. It is that point where a reduction in the air supply results in incomplete combustion and an increase in the air supply results in an unnecessary waste of energy through the carrying away of sensible heat by excess volumes of flue gases. An idea of the magnitude of the fuel losses due to the escape up the stack of combustible gases when the air supply is insufficient, as compared to the losses due to the presence of excess air, may be gained by a comparison of the curves in Figs. 1 and 2. In Fig. 1 we have a curve showing the fuel losses which take place with varying percentages of CO_2 (varying inversely with the excess air supply) in the flue gases, providing there are no combustible gases present. However, combustible gases (CO, CH_4 and H_2) are bound to begin to form at some point as the percentage of CO_2 is increased (air supply decreased) and, as mentioned before, losses due to the formation of these combustible gases are far greater in proportion to their volume than losses indicated by equivalent proportions of CO_2. This is graphically illustrated in Fig. 2, where the portion *CB* in the curve represents fuel heat losses that develop beyond the point *C* where combustible gases begin to form as the percentage of CO_2 is still further increased by reducing the air supply. The point *C* is the critical point. It is the point where combustion takes place with the greatest economy in fuel consumption. It varies not only in different furnaces, but varies constantly in the same furnace.

The curves shown were plotted from generally accepted average values. On that basis the following comparisons are interesting. Let us assume that when CO_2 is 14% combustion is taking place under conditions of maximum efficiency in the furnace. The unavoidable loss under these conditions is 15.3% of the total fuel used. Let us assume that only 1% of combustible gases forms for every percent increase in CO_2 beyond this point. Taking into account the heating value of these combustible gases, calculations show that when the CO_2 reaches 15%, the fuel loss is 22%, and when the percentage of CO_2 has reached 16 the percentage of fuel loss becomes 28.

Many power-plant engineers consider it useless to place much confidence in CO_2 readings and make it a general rule never to allow the CO_2 present to exceed 10 to 12%. Others put it as low as 8 to 10%. Under these conditions there is likely to be a great waste of fuel due to the avoidable escape of sensible heat up the chimney. In contrast with these there are authorities who claim there is no danger of having combustible gases escape unconsumed before CO_2 reaches a point above 15%. The fact of the matter is that combustible gases may appear with any percentage of CO_2, and depending on CO_2 records alone may be decidedly misleading. It is quite possible to have large volumes of combustible gases (CO, CH_4 and H_2) present simultaneously with a low percentage of CO_2 as well as with a high percentage of CO_2. For example, if the fire in one part of the furnace is very thick or dirty CO would be generated in that part and escape unburned because not enough air would be going through. If, at the same time, there is an air hole in another part air would rush through there unused. Under these

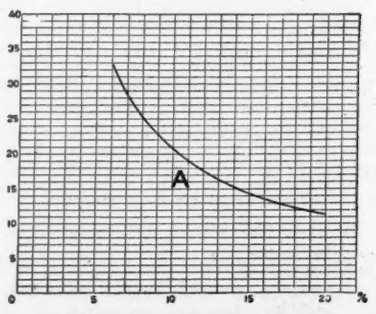


Fig. 1.—Diagram Showing Relation of Flue-Gas Heat Loss to Percentage of CO_2.

conditions CO would be found present at the same time that the record would indicate excess air by a low CO_2 reading.

The percentage of CO_2 for economical combustion may vary considerably from time to time in the same furnace with the rate of combustion, method of firing, thickness of the fire bed, distribution and character of the fuel, draft, formation of ashes, dirt and clinkers, and many other influences which are subject to irregular variations, and which have a decided effect upon the completeness and efficiency of combustion with any given-air supply. Generally speaking low CO_2 indicates excess air, but may also indicate that the air is poorly mixed, giving rise to a simultaneous formation of CO. It is therefore not desirable to attempt to secure a high percentage of CO_2 by cutting down the draft alone. A high percentage of CO_2 can be obtained with practically any draft so long as it has the proper relation to the fuel-bed resistance. On the other hand, the losses due to the formation of combustible gases which are allowed to escape up the chimney without being burned may be much greater than the losses due to excess volumes of air, because it is quite pos-

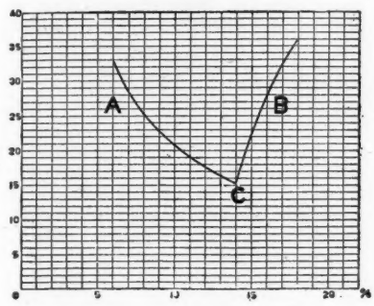


Fig. 2.—Diagram of Flue-Gas Heat Losses When Combustibles Appear at 14% CO_2.

sible to reach a high percentage of CO_2 while simultaneously producing large volumes of combustible gases.

Insufficient air supply is the most general cause of the presence of CO in the stack. CO may, however, be present due to the poor design of the furnaces, improper methods of firing, the coal being of a character not adapted to the equipment with which it is burned, poor mixing of the combustible gases with the air and low furnace temperature, which causes gases to be cooled below the ignition point before combustion is complete. Occasional snap tests for CO with hand instruments to check up the CO_2 recorder have proven deficient in properly controlling combustion.

Oxygen used in the process of combustion in a furnace comes from two sources, namely, the primary and the secondary air supply. The primary air supply is that which flows through the combustible material in the fire bed. The secondary air supply is that which is admitted to the combustion chamber above the fire through holes in the fire bed, the fire doors, through leaks in the boiler settings, etc. It supplies the free oxygen necessary to oxidize the combustible gases generated in the fire bed. The Bureau of Mines has conducted exhaustive experiments to determine what actually happens when coal is burned in a furnace. It was discovered with one fuel, that when the fuel bed is over 4 ins. thick, and free

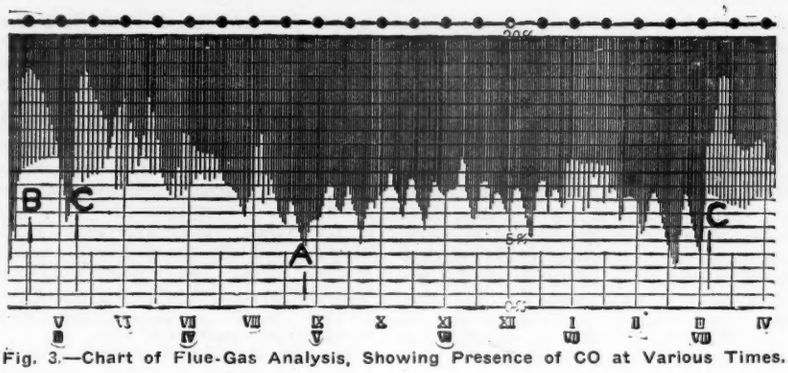


Fig. 3.—Chart of Flue-Gas Analysis, Showing Presence of CO at Various Times.

from air holes, a furnace without secondary air acts very much like a gas producer. In a fuel bed 12 ins. thick, where no secondary air was supplied, practically all the oxygen was consumed 4.5 ins. from the bottom of the fire. At this point the CO_2 reached 14% and combustible gases registered 10%. About 26% of the gases leaving the top of the fire were combustible gases, while the percentage of CO_2 was reduced to 7. Le Chatelier states that CO_2 generally reaches a maximum at a height in the fuel bed ten times the diameter of the coal pieces. From this point on reduction of CO_2 takes place.

The combustion of coal in an ordinary boiler furnace thus takes place in two stages. In the first stage the fuel bed acts as a gas producer, producing CO and other combustible gases in large volumes. In the second stage these combustible gases are mixed with the secondary air and the carbon in the CO and other combustible gases is oxidized to CO_2, and the hydrogen combines with oxygen to form water vapor. Contrary to the generally prevailing impression, the volume of secondary air required to burn coal in a furnace is greater than the volume of the primary air. If the coal were all carbon the volume of the secondary air required under ideal conditions would be the same as the volume of the primary air. In the first stage of combustion the reaction would be $2C + O_2 = 2\ CO$. In the second stage it would be $2\ CO + O_2 = 2\ CO_2$. In other words, the volume of air required to convert the carbon into CO in the primary stage is the same as the volume of air required to burn the CO into CO_2 in the secondary stage. However, there are other gases than CO which come off in the first stage of burning coal. To burn these additional gases secondary air is required. Inefficient mixing of the combustible gases with the secondary air supply gives rise to still further demands for excess secondary air in order that complete combustion may take place. How much secondary air is required depends on the furnace design, kind of stoker, method of firing, kind of fuel, etc.

It is impossible to analyze the supply of secondary air as to where it all comes from, how much enters through the various known channels, or what its proportion to the total air supply is. It is generally recognized, however, that it is best to keep it at the least possible minimum necessary to insure complete combustion. This can only be done by a constant watch for the appearance of combustible gases in the flue, while holding the percentage of CO_2 at the maximum point which can be maintained without the appearance of such combustible gases. Holes, ashes, clinkers, or dirt in the fire, thickness of the fuel bed, draft, length of time of opening of fire doors and regulation of dampers, all cause wide and irregular fluctuations in the amount of secondary air admitted. While the amount of this secondary air has such a decided and important effect on the economical combustion of the gases which are formed in the fire bed it is a most bewildering and hopeless task for the fireman to attempt to control it scientifically, or to form any conclusions, or to make estimates based on direct observation regarding the proportion or amounts of this secondary air entering at any time. To achieve efficient furnace results some clear and simple means should be provided to tell just how much excess air is present at all times, and to give prompt warning of the appearance of combustible gases in the chimney. Such means act as a guide for the fireman, enabling him to regulate his fires and manipulate to the best advantage the controllable elements which determine the admission of excess air to the combustion chamber.

The best method of firing a particular furnace and regulating the air draft and dampers can be determined by trying various ways and means and carefully watching the results recorded from the analysis and recording of both CO_2 and combustible gases. Through such a procedure the fireman can learn by experience what must be done, and what must be avoided, to give the maximum percentage of CO_2 without the loss of combustible gases up the flue. Without such a continuous and complete record of both CO_2 and combustible gases he is working without full information.

Correct mixing of the air and the volatile combustible products of the furnace is a matter of importance, and represents one of the problems of design the combustion engineer has to contend with in his efforts to cut down the amount of excess air necessary to insure complete combustion and to reduce the possibilities of having unconsumed combustible gases escape up the chimney. Stratification, having the process of mixing take place too slowly, or premature cooling of the mixture below the ignition point all lead to waste.

How nearly combustion in practice can reach the ideal is well represented in certain boiler plants where blast-furnace gas is the fuel. By means of a multiplicity of interspersed small air and gas orifices such a thorough mixture of the fuel and air is obtained that the percentage of excess air necessary to insure complete combustion has been practically reduced to zero. On the other hand, it is not at all uncommon to find in small coal-burning boiler plants,

where hand firing is used, that the CO_2 in the flue-gas analysis registers as low as 4%.

In a paper by Ambrose N. Diehl on "Modern Methods of Burning Blast Furnace Gas Under Stoves and Boilers," the following statement appears: "In view of the fact that 1% of CO in flue gas containing 18% of CO_2, adds approximately 6.5% to the losses, and a proportionate larger amount in more dilute gases, it becomes apparent that a high degree of accuracy in the CO determination is very desirable. For this reason, efficiencies based on analyses of a CO_2 recorder are not dependable." He states further that constant gas analysis and intelligent supervision are the principal factors in obtaining continuous good efficiency and control.

By continuously recording the percentage of CO_2 as an indicator of the amount of excess air present, and by detecting and clearly recording the presence of combustible gases (CO, CH_4 and H_2) immediately they are present, effective combustion control can be established. Graphic records of such a combination of simultaneous gas analyses, considered in conjunction with other records and the various functions in boiler-room operation, point the way toward improving combustion in a given furnace and help to indicate needed alterations and improvements.

An instrument has been developed and placed on the market by the Mono Corp. of America, New York City, which not only analyzes and records the percentages of CO_2 present at all times in flue gases, but also detects and records on one and the same chart the presence and the approximate proportion of combustible gases whenever they appear. Olof Rodhe, chief engineer of the corporations, states that his experience with a great many plants both in America and Europe has conclusively proven that "economical combustion is possible only when combustion control is based on records indicating not only excess air, but also the presence of combustible gases due to an insufficient supply of air."

One of the prime purposes of the "Duplex Mono" is to detect the presence of combustible gases in the flue immediately upon their appearance, and to record the percentage of CO_2 present at that particular time. The presence of combustible gases once established, the accurate determination of their actual percentages is not of any importance. The instrument indicates approximately the degree in which they appear, and that is sufficient for the guidance of the fireman. The actual percentage present is rarely less than two-thirds, or more than equal to the amount recorded on the chart. Even where the old conditions were considered as most favorable, the installation of these instruments has demonstrated that incomplete combustion was prevalent to a greater degree in modern boiler plants than was suspected. Fig. 3. represents a diagram made by one of these new double-recording instruments. The lower contour of the diagram represents the percentages of CO_2 present at all times. The lighter areas in the diagram indicate the presence of combustible gases. The proportion of combustible gases present is roughly indicated by the height of the lighter areas at any particular time.

Looking closer at this diagram, it will be seen that at the point *C*, farthest to the left, combustible gases began to appear when the percent of CO_2 was 10, and the amount of combustible gases increased rapidly as the CO_2 increased to 11%, only to vanish again when the CO_2 was again reduced to 10%. At point *C*, to the right, combustible gases begin to appear again, this time, however, when CO_2 is only 8.5%. This shows that betwen 4:30 in the morning and 3 o'clock in the afternoon, changes have taken place in the furnace conditions such that while combustible gases began to appear when CO_2 was 10% early in the morning they began to appear when CO_2 was only 8.5% in the afternoon.

Fig. 3, which has just been discussed, shows the condition found in a boiler plant at the time an instrument was first connected, and the furnace was operated on the old principle. Certain changes were made in the furnace, the nature of the fuel, and the method of firing, with the result that conditions as illustrated in Fig. 4 were obtained. In this diagram it is seen that CO_2 was carried to a point as high as 13% without the formation of CO. In other words, the critical point was raised several points higher on the diagram. With such a record always before him the operator should be in a position to follow any variations in the positions of the critical point and know when combustible gases begin to escape unburned up the chimney. Where the dark contour goes below the critical point too much air is supplied, or there is improper distribution of air. Where, on the other hand, the dark contour rises above the critical point, that is, the point where light areas begin to show, the supply of air is insufficient.

The apparatus used for making these records, shown in Fig. 5, is driven by water pressure of about 10 lbs. per sq. in. Before entering the instrument the gas samples from the flue are passed through a filtering system which removes all traces of soot and dirt. They are then passed into and forced through the apparatus by a mercury piston. There are no mechanical valves, such functions as these might fulfill being performed by various kinds of mercury seals, traps, etc. Samples of gas are forced alternately through two routes; one leading directly through a caustic-potash tank where CO_2 is absorbed, and the other first through an electrically heated furnace wherein the combustible gases are oxidized to CO_2 and H_2O, and then through the caustic-potash tank. Samples that are forced through the caustic-potash tank only give the readings for CO_2. Those that are first forced through the electrically heated furnace and then through the caustic potash tank give readings of CO_2 plus combustible gases. The difference between any two successive readings is proportional to the amount of the combustible gases present.

In the electrically heated furnace, the oxygen necessary to oxidize the combustible gases, CO, CH_4 and H_2, to form CO_2 (which is later absorbed in the caustic-potash tank) and water (which is condensed) is usually taken from the air which is almost invariably present in flue gases even when combustible gases are present. When such free oxygen is not available, oxygen is taken from copper oxide provided in the furnace for that purpose. The copper oxide, however, probably seldom acts as anything but a catalytic agent and need never be renewed. To diminish the lag between the time when the gas leaves the flue and the analysis is recorded on the chart, small communicating tubes are used. The recording pen, when at its highest position, comes into contact with an ink container having a two weeks' supply of ink. The ink in the pen is automatically replenished every time it returns to the high point on the chart. The apparatus is practically dustproof and requires only a slight amount of attention, which consists in winding the clock once a week, replacing the caustic-potash solution two or three times a month, replenishing the ink supply twice a month, and putting in new rolls of paper.

Readings indicating the presence of combustible gases are exaggerated, if anything, by the "Duplex Mono," this being considered an advantage.

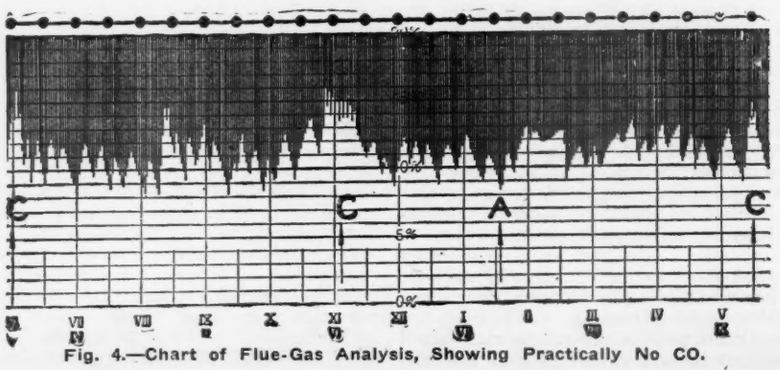


Fig. 4.—Chart of Flue-Gas Analysis, Showing Practically No CO.

A Growler for Testing Armature and Field Coils.

An automatic growler has been placed on the market by the Quality Electrical Products Co., 907 East 15th street, Kansas City, Mo. This growler possesses a number of distinctive features not found in the older types. An automatic switch opens the a-c. circuit when the growler is not in use, thus removing a source of fire hazard and effecting a saving of current. An adjustable shunt bar is used for varying the reluctance of the magnetic circuit. The use of this bar, together with a switch for changing winding connections from series to parallel, makes the device available either for testing motor armatures and series field coils, or for generator-armatures and shunt-field coils. A specially designed testing "bug" is a part of the growler equipment. This consists of an aluminum shell in which is fitted loosely a thin piece of flat steel. When passed over the armature under test the steel will vibrate and act as a buzzer, thus instantly indicating the presence of any current which may be flowing in the coil.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Loud Speaking Telephone Co., New York City, has leased space at 1457 Broadway for new local headquarters.

Lundin Electric & Machine Co., New Haven, Conn., has filed notice of increase in its capital stock from $20,000 to $100,000 for expansion.

Wald Electric Manufacturing Co., 417 Canal street, New York City, has filed notice of increase in its capital stock from $50,000 to $75,000.

Thew Automatic Shovel Co., Lorain, O., has issued catalog No. 10 illustrating and describing its line of electric, steam and gasoline shovels for various purposes.

Kohler Co., Kohler, Wis., has issued a 24-page booklet descriptive of the "Kohler" automatic power and light 110-volt d-c. system for farm and other isolated plant uses.

Localized Lighting Co., Providence, R. I., manufacturer of electric lighting equipment, has filed notice of change of name to the Franklin Specialty Manufacturing Co.

Binghamton Electric Truck Co., Bighamton, N. Y., manufacturer of electrically operated trucks, has filed notice of increase in its capital stock from $200,000 to $1,200,000.

Northwestern Electric Co., New York City, has recently removed its local headquarters from 1457 Broadway to 6 Church street, where increased facilities are provided.

Hanson & Van Winkle Co., 267-71 Oliver street, Newark, N. J., manufacturer of electric motors and parts, has filed plans for extensions and improvements in its plant to cost about $25,000.

International Combustion Engineering Co., 11 Broadway, New York City, has acquired control of the Combustion Engineering Corp., same address, and the Underfeed Stoker Co., Ltd., London, Eng.

The H. W. Manufacturing Co., Los Angeles, Cal., of which A. E. Treat is secretary, plans to change its name to the R. & W. Electrical Manufacturing Co., to specialize in the manufacture of electrical machinery and equipment.

Crocker-Wheeler Co., Ampere, N. J., manufacturer of electric motors, generators and transformers, has moved its Boston office to larger quarters at 171 High street (Cornhill Square). L. S. Howland continues as district manager.

Western Tool & Engineering Co., 1310 East Sixth street, Los Angeles, Cal., has been organized by N. E. Brown, formerly superintendent of the U. S. Electrical Manufacturing Co., Los Angeles, and S. W. Fitts, formerly superintendent of the Worcester (Mass.) Stamped Metal Co.

Cortlandt Cycle & Electrical Supply Co., New York City, has leased property at Cortlandt and Greenwich streets for a term of years for a new local establishment.

Westinghouse Electric & Manufacturing Co. has purchased a 12-acre tract of land in Emeryville, Cal., adjoining the Southern Pacific tracks, for the erection of a building, the first unit of which will have 12,000 ft. of floor space.

Evansville Electric Manufacturing Co., Evansville, Ind., operating a local plant for the manufacture of electrical specialties, has been incorporated with a capital of $25,000 for proposed expansion in operations. John Polling is president.

Westinghouse Lamp Co., Bloomfield, N. J., has inaugurated a 5-day week schedule at its local plant, replacing a 4-day week heretofore operated. The plant is now giving employment to about 1800 operatives, or approximately 400 less than normal.

Fahnestock Electric Co., Meadow street, Hunter's Point, L. I., N. Y., will occupy two floors of its new building at Eighth street and East avenue, Long Island City, for the manufacture of electrical products, and will lease the three additional floors to other industrial interests for the time being.

Industrial Electric Co., 432 North State street, Chicago, which was recently organized, will conduct a general electrical contracting business in connection with the installation of industrial plant equipment. The officers of the company are: President, W. M. Swanson; treasurer and general manager, N. M. Thompson, Jr.

Copper Clad Steel Co., Rankin, Pa., have issued the following announcement: "The Page Steel & Wire Co., who formerly drew and sold our wire, are no longer associated with the 'Copperweld' product. Our new wire mills are completed and for the first time in the history of Copper Clad the entire manufacturing operation is controlled by one organization."

Utility Compressor Co., Detroit, of which E. R. Hasse is president, plans to move to Adrian, Mich., where it will erect a factory with a floor space of 20,000 sq. ft. The company was organized in 1913 and was originally engaged in the manufacture of air compressors and vacuum pumps for garage and laboratory purposes, but for some time past has been devoting its attention to the manufacture of electrically-controlled refrigerating equipment.

Crouse-Hinds Co., Syracuse, N. Y., has issued an illustrated folder covering its ZY condulets for the control of small motors. The merits of these condulets are thus set forth by the manufacturer: Substantial cast-iron housing protecting the mechanism from mechanical injury, lint, dust and moisture; access to the interior of the condulet is impossible unless the switch is in the "off" position; it is impossible for the operator to come in contact with live parts when renewing fuses; made with various sizes and combinations of conduit hubs.

Electrical Engineering Co., Pittsburgh, has acquired property, with factory at 208-12 Cremoe street, Northside, for a new works. A consideration of about $19,000 was given for the factory.

General Electric Co. will continue in operation the recently acquired plants of the Independent Lamp & Wire Co. The plant at York, Pa., will be known as the York Insulated Wire Works of General Electric Co., while the factory at Weehawken, N. J., will be divided into two separate plants known as the Weehawken Lamp Works of General Electric Co., which will eventually become entirely a lamp-exporting establishment, and the manufacture of contact points will be conducted under the name of the Elkon Works of General Electric Co.

Cutler-Hammer Manufacturing Co., Milwaukee, has issued bulletin 9116, known as publication 2016, describing and illustrating the C-H inclosed switch used for starting polyphase squirrel-cage motors. The folder states that this switch protects the motor by inserting the fuses in circuit only after the motor has reached speed, thereby avoiding the overfusing of the motor to carry the heavy in-rush current. The totally inclosed structure of the switch protects the workman from injury by accidental contact with live parts. When the switch is "off" and the fuses are dead, a sliding panel on the inclosing case can be lowered to allow inspection and renewal of the fuses.

Marlin-Rockwell Corp., 366 Madison avenue, New York City, has again assumed the management of the Rockbestos Products Corp., New Haven, Conn. The new officers of the latter company are: President, George H. Houston; vice-president and general manager, Guy Hutchinson; treasurer, Harold C. Pryer; secretary, Ralph A. Gamble, and assistant treasurer and assistant secretary, I. H. Charlotte. The executive committee consists of George H. Houston, A. J. Brosseau and William M. Cannon. On the board of directors are George H. Houston, William M. Cannon, W. L. Walker, G. Harmann Kinnicutt, A. F. Rockwell, A. J. Brosseau and George A. Carden, all of New York City. At present both the Whitney Hill and Willard street plants at New Haven are being operated under the management of Guy Hutchinson, but after the installation of new machinery the two will be consolidated and only the latter factory maintained.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

T. A. GRESHAM has been placed in charge of the securities department of the Muskogee Gas & Electric Co., Muskogee, Okla.

EARL W. MELVILLE and R. DELANCY DAVIS have joined the bond department of H. M. Byllesby & Co., Minneapolis office.

A. A. KING has accepted a position as chief electrician with the Phelps-Dodge Corp., Copper Queen Branch, mines department, Bisbee, Ariz.

W. T. KYLE has been appointed assistant general manager of sales of the Page Steel & Wire Co., 1054 Grand Central Terminal, New York City.

EDWIN E. H. HUGLI has accepted a position as structural engineer of the electrical department of the Hydroelectric Power Commission of Ontario.

C. A. MORRIS, formerly with the Northumberland Paper & Electric Co., Ltd., is now connected with the Canadian Paperboard Co., Frankford, Ont.

W. A. RATTENBURY, sales manager of the hardware division of Landers, Frary & Clark, New Britain, Conn., has been elected a vice-president of the company.

ORVILLE P. PALMER, purchasing agent of the Pratt & Whitney Co., Hartford, Conn., has been elected president of the Purchasing Agents' Association of Connecticut.

WALLACE B. KIRKE has been appointed assistant to the chief electrical engineer of the New York Edison Co. He was formerly connected with the General Electric Co.

A. P. VAN SHAICK has been appointed general manager of sales of the Page Steel & Wire Co., Grand Central Terminal, New York City, to succeed E. C. Sattley, who has resigned.

F. E. WHITCOMB, special representative of the Federal Signal Co., Albany, N. Y., has been elected vice-president and general manager of the Consolidated Equipment Co., Ltd., Montreal, Can.

F. O. HALE has been appointed chief engineer of the Illinois Bell Telephone Co., with headquarters in Chicago. He has been general manager of the Southwestern Bell Telephone Co. in Missouri since 1916.

C. F. BLACKMER, assistant superintendent of the American Steel & Wire Co.'s plant at Waukegan, Ill., has been appointed superintendent of the new wire mill being constructed in connection with the Minnesota Steel Co.'s plant at Duluth, Minn.

A. C. NELSON, formerly connected with S. B. Condit, Jr., & Co., Boston, has been appointed New England sales manager of the Arrow Electric Co., Hartford, Conn. He will make his headquarters in room 621 Rice Building, 10 High street, Boston.

H. M. BOYLSTON, head of the mining engineering department of the Case School of Applied Science, Cleveland, addressed members of the Engineers' Club of the Youngstown district recently on the subject of "Metallography and Its Applications."

J. P. PULLIAM, who was recently elected president of the Wisconsin Electrical Association, is a native of Louisville, Ky. His early training was as a telegraph operator, agent and chief clerk to the superintendent of the Kentucky-

J. P. Pulliam.

Indiana Bridge Co., and afterwards with the Southern railway at Louisville. In 1904, he became connected with the Grand Rapids, Grand Haven & Muskegon Railway Co. at Fruitport, Mich., as trainmaster, and continued with that company until July, 1907. In the same year he became superintendent of the Winnebago Traction Co., Oshkosh, Wis. As a result of a reorganization his duties were extended to cover the operation of the Eastern Wisconsin Railway & Light Co., which operates the electric, gas and street railway utilities at Fond du Lac, Wis., with an interurban line to Oshkosh. When this property was sold to the present owners in April, 1917, Mr. Pulliam tendered his resignation and became affiliated with Clement C. Smith, of Milwaukee. For six months in 1917 Mr. Pulliam was stationed in Green Bay as general manager of the Wisconsin Public Service Co., and since Jan. 1, 1918, he has been located in Milwaukee in charge of the operation of the public utilities, of which Mr. Smith is president.

J. L. KILPATRICK, assistant vice-president and general manager of the Bell Telephone Co. of Pennsylvania, gave a talk on present business conditions before the members of the Harrisburg (Pa.) Telephone Society last month. At the annual election of officers, R. M. Leonard was made president of the Society for the coming year; R. P. Sharp, vice-president; William Bradford, secretary, and H. F. Wile, treasurer.

J. B. SCHEEFERS, Oklahoma City, Okla., has been appointed gas and electrical engineer of the Oklahoma Corporation Commission. He was formerly in charge of the electrical and mechanical engineering work of Morris & Co., packers, Oklahoma City, and later was connected with the United Electric Co. of that city.

C. H. SHEPHERD, formerly electrical engineer in charge for the Commissioners of Lincoln Park, and chief layout engineer of the Bureau of Engineering and Construction, Departmet of Gas and Electricity of the City of Chicago, has severed his connection as department engineer for the Bemis Co., and has announced the opening of an office at 440 Monadnock building, Chicago, as consulting engineer, specializing in street lighting and general power system engineering.

DR. R. S. MACELWEE, director of the Bureau of Foreign and Domestic Commerce, Washington, D. C., has resigned to accept the position of director of the School of Foreign Service, Georgetown University. Dr. MacElwee came to the Bureau, Jan. 2, 1919, in the capacity of special agent, was made second assistant director Feb. 20, 1919, and director on July 1, 1920. He has had 20 years' experience in foreign trade, including a number of years in France and Germany.

OBITUARY.

ROBERT A. BOLE, vice-president, director and district sales manager at Pittsburgh for Manning, Maxwell & Moore of New York City, died recently at the age of 62 years. He was born in Allegheny, Pa., and early in life became connected with the Westinghouse Machine Co. of the Westinghouse Electric & Manufacturing Co., where he rose to be secretary. Mr. Bole later resigned to become associated with Manning, Maxwell & Moore.

CECIL P. POOLE died recently in Norfolk, Va., where he had gone to reestablish his practice as a consulting engineer. He was born in Elizabeth City, N. C., Oct. 16, 1863, and began his practical work with the old Brush arc-lighting station at Norfolk in 1884, taking charge of the lighting and power plant at Lynchburg, Va., 3 years later. He continued to operate it on his own account under lease after he started contracting engineering in 1888. He devoted several years of his life later to technical writing. In 1912 he moved to Atlanta, Ga., where he became identified with the engineering department of the city, being in charge of the work of the department of inspection. Mr. Poole was a fellow of the American Institute of Electrical Engineers.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

East Deering Me.—The Grand Trunk Railway Co., Montreal, Can., is considering the erection of a local coaling plant, estimated to cost $1,000,000, with machinery. Electrically operated freight handling machinery for loading, unloading, conveying, etc., will be installed by the company in connection with the proposed extensions to its steamship terminal at Portland, Me., estimated to cost $500,000.

Danvers, Mass.—Considerable electrical machinery and equipment will be installed by the Romer Motor Corp. at its proposed new local plant for automobile assembling. The company was recently organized with a capital of $5,000,000. A. J. Romer, formerly connected with the Northway Motor Corp., Natick, Mass., is president.

South Braintree, Mass.—Electrically-operated machinery will be installed in the 3-story plant to be constructed by the Monatiquot Rubber Works Co., to replace its factory recently destroyed by fire. The new plant will total about 20,000 sq. ft. in floor area, and is estimated to cost $200,000.

Worcester, Mass.—The Worcester Electric Light Co. has made application to the Department of Public Utilities for permission to issue additional stock to the value of $620,000, the proceeds to be used for general operations, extensions, etc.

Woonsocket, R. I.—Considerable electrical equipment will be installed in the worsted mill to be erected by Lepoutre Brothers on Manville road. Auguste Lepoutre is president. W. F. Fontaine, Federal building, is architect.

Antwerp, N. Y.—The Antwerp Light & Power Co. has made application to the Public Service Commission for permission to construct an addition to its local power plant, and for approval of a franchise for lighting recently granted in this district.

Brooklyn, N. Y.—Considerable electrical equipment will be installed in the 4-story and basement Y. M. C. A. building, to be located at Richards and Sullivan streets. John F. Jackson, 141 East 45th street, New York City, is architect; Paul J. Platti, 141 East 45th street, New York City, is electrical engineer for the work.

Buffalo, N. Y.—The Niagara Falls Power Co. is perfecting plans for the construction of its proposed transmission line to Buffalo, across Grand Island. In accordance with agreement with the Federal Water Power Commission, Washington, for the utilization of additional water from Niagara Falls, this line must be completed by Sept. 1, 1921. The line will be used for additional power supply for the city. The power plant to be constructed must have the first unit of generating machinery in operation by May 1, 1923, in accordance with the terms of the permit. The entire project is estimated to provide about 100,000 h.p. additional.

Burlington, N. Y.—The Public Service Commission has granted permission to D. Thorne Gardner, Burlington, for permission to construct and operate electric power plants at West Burlington and Edmeston, Otsego county, with local distributing lines in this section. Approval of franchise has also been given.

New York, N. Y.—The Hotel Netherlands, 59th street and Fifth avenue, has arranged for the discontinuance of its private generating plant, and in the future will use central-station service, securing energy from the New York Edison Co. The total installation aggregates 6000 lamps and 370 hp. All equipment, such as pumps, refrigerating system and elevators, will be electrically operated.

New York, N. Y.—The New York Edison Co., 130 East 15th street, is taking bids for the erection of its proposed substations on Green and Cedar streets, respectively. The structures will be brick and concrete, and are estimated to cost $160,000 and $130,000, in the order noted. W. Whitehall, 12 Elm street, is engineer.

New York, N. Y.—The Cities Service Co., 60 Wall street, operating utility properties in different parts of the country, is arranging for an increase in its capital stock from $50,000,000 to $100,000,000.

Old Forge, N. Y.—The Village Council is perfecting plans for the construction of a municipal electric power plant. Application has been made to the Public Service Commission for permission to build the plant and install a local distributing system.

Perry, N. Y.—The Perry Electric Light Co. has filed application with the Public Service Commission asking permission to build an electric power plant addition at Genesee Falls.

Poplar Ridge, N. Y.—The Poplar Ridge Cayuga County Lighting Co. has made application to the Public Service Commission, Second District, for authority to construct a public lighting plant to serve the town of Venice.

Salamanca, N. Y.—The Salamanca Central Electric Co. has been incorporated with a capital of $10,000 to operate a local electric light and power system. The incorporators are A. L. Varley, S. W. Coston and A. E. Krieger.

Rochester, N. Y.—Sibley, Lindsay & Curr Co., Clinton avenue, operating a local department store, has awarded a contract to A. W. Hopeman & Sons, 569 Lyell avenue, for the erection of its proposed 1-story power plant, to be used for electric service for general operations.

Millville, N. J.—The Millville Light & Power Co. is planning the erection of an electric generating plant to cost about $250,000 with equipment.

Ormond, N. J.—The E. I. duPont deNemours Co., Wilmington, Del., is planning the construction of a power plant in connection with its proposed black powder works at Manimuskin, near Ormond.

Trenton, N. J.—The City Commission is arranging for the immediate installation of new street lamps in upper Stacy Park to complete the illumination of the municipal grounds.

Milton, Del.—The City Council has awarded a new street-lighting contract to the Milton Electric Co., the agreement providing for the installation of a number of new 300 and 100 cp. lamps, and improved lighting system in the business district.

Danville, Pa.—The Board of Trustees of the Danville State Hospital for the Insane is planning the construction of a 1-story power plant at the institution to cost about $65,000. William F. Shay, Watsontown, is president of the board.

Ellwood City, Pa.—The Pennsylvania Power Co. has filed a complaint with the Public Service Commission, asking that the Harmony Electric Co. be restrained from distributing electric energy from its high-tension lines in violation of an agreement.

Harrisburg, Pa.—The Harrisburg Light & Power Co. has made application to the Public Service Commission for permission to issue bonds for $33,000 for extensions and betterments.

Lancaster, Pa.—The Public Service Commission has approved the merger of a number of electric utilities operating in Lancaster county under the name of the Lancaster County Light, Heat & Power Co., with nominal capital of $40,000. The companies merged are the Martic-Drumore, East Drumore, Fulton, Drumore, Little Britain and Colerain Electric companies. R. H. Long is president, and L. R. Ambler, secretary and treasurer. Headquarters will be at Lancaster.

Millvale, Pa.—The Millvale Light Co. has been incorporated with a nominal capital of $5000 to operate a local electric light and power system. C. J. Braun, Jr., 435 Sixth street, Pittsburgh, is treasurer.

Philadelphia, Pa.—The United States Quartermaster Department, U. S. Government, is taking bids for the construction of a power house at 21st and Oregon streets.

Pittsburgh, Pa.—The Duquesne Light Co. has called a special meeting of stockholders May 24, to approve a reduction in the capital stock of the

company to $34,822,300. W. B. Carson is secretary.

Pittsburgh, Pa.—Considerable electrical equipment will be installed in the proposed plant of the Crane Co. on 24th street, Pittsburgh, estimated to cost $1,000,000 with equipment. The works will be used for the production and sale of valves, steam specialties, etc. The Hunting-Davis Co., Century building, Pittsburgh, is architect.

Reading, Pa.—Electrical and mechanical equipment will be installed at the proposed filtration plant to be constructed by the City Council, with cost estimated at $800,000.

Scranton, Pa.—The Millstone Township Forest Electric Co. has been incorporated with a nominal capital of $5000 to install and operate an electric light and power system in different parts of Millstone township. E. H. Ramsbotham, Scranton, is treasurer.

Shippensburg, Pa.—A local company is being organized by George S. McLean and Lee M. Hale to construct and operate an ice-manufacturing and cold storage plant. Considerable electrically operated machinery will be installed.

Shippensburg, Pa.—The Shippensburg Gas & Electric Co. has commenced the installation of new equipment at its plant for increased power service.

Sunbury, Pa.—The County Court has authorized the sale of the Sunbury and Susquehanna electric railway, the Sunbury and Selinsgrove railway system, and the Sunbury, Lewisburg and Milton electric railway system, all of which have been operating under a receivership since 1913. The date of sale has been fixed for April 25.

Baltimore, Md.—The Electrical Commission has been granted an appropriation of $5000 for immediate operation and maintenance work. The operation of the department is estimated to cost about $13,500 in excess of a regular fund.

Baltimore, Md.—The Public Improvement Commission is planning for a survey of the municipal electrical conduit system and proposes to engage an electrical engineer for this purpose. It is planned to expend about $1,000,000 for extensions in the near future. The existing installation represents an investment of close to $6,000,000.

Baltimore, Md.—In connection with an application for increased rates by the Consolidated Gas & Electric Co., the Public Service Commission has authorized a complete inquiry into the affairs of the gas manufacture and operations of the company.

Bel Air, Md.—The Public Service Commission has granted permission to the Baltimore & Bel Air Electric Co. to issue stock for $25,000, the proceeds to be used for line extensions and betterments.

Canton, Md.—The Standard Oil Co. has completed plans for the erection of a 1-story power house at its local oil works to cost about $50,000.

Glen Burnie, Md.—Grover C. Morgan has been granted a franchise for the installation and operation of a light and power system. The Public Service Commission has approved the franchise.

Hagerstown, Md.—The Hagerstown & Frederick Railway Co. has made application to the Public Service Commission for permission to issue bonds for $1,600,000, to be used in part for extensions, improvements, etc.

Williamsport, Md.—W. D. Bryon Co. plans to erect a 1-story boiler house addition to its electric power plant, plans for which have been prepared by Quigley Hafer, architect, 155 Garfield street, Chambersburg, Pa.

Chatham, Va.—The Chatham Light & Power Co. plans to erect an additional unit at its power plant to double the present capacity.

Quantico, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning the installation of a new power and lighting system at the local naval property.

Charleston, W. Va.—The Moyer-Shewey-Thurston Electric Co., 303 State Bank building, has been incorporated with a capital of $100,000 to operate a local electric light and power plant. H. D. Moyer is president, and J. A. Thurston, treasurer and general manager.

Charleston, W. Va.—The Georges Creek Coal Co. is planning the installation of new machinery at its properties, to include electrical apparatus, haulage motors, etc. A new tipple will be constructed. The company had recently increased its capital stock to $500,000 for expansion. J. M. Harris is secretary and treasurer.

Huntington, W. Va.—The Parsons Coal Co., 418½ Tenth street, will soon take bids for new electric equipment, pumping machinery, hoisting apparatus and other machinery for installation at its mining properties. A. F. Parsons is president and manager.

Huntington, W. Va.—Considerable electrical equipment and machinery will be installed by the International Nickel Co., 43 Exchange place, New York City, at its proposed local plant and rolling mill, erection contract for which has been awarded to the McClintic-Marshall Co., Pittsburgh. The plant will consist of a number of 1-story buildings, and is estimated to cost in excess of $2,000,000. Frank I. Ellis, Farmers' Bank building, Pittsburgh, is consulting engineer.

Man, W. Va.—The Man Mining Co. has made application for a local franchise for the installation of an electric lighting system.

Romney, W. Va.—The Romney Power Co., recently organized, has made application to the Public Service Commission for permission to construct a dam across the Potomoc river in this section for impounding waters for the operation of a hydroelectric generating plant. James O. and E. H. Blue head the company.

Romney, W. Va.—The Farmers' Electric Co. has been incorporated by officials of the Romney Power Co. to install and operate a local electric light and power system. James O. Blue and J. W. Shull head the company.

Wheeling, W. Va.—Erection of a $50,000 power house at the Manchester plant of the Whitaker-Glessner Co. is planned. Address Harry A. Conrad, city manager.

Charlotte, N. C.—The Southern Power Co. is considering the preliminary plans for the construction of a new steam-operated power plant on Mountain Island, with transmission system to connect with the present lines. The project is estimated to cost close to $10,000,000.

Cornelius, N. C.—The Common Council is arranging for a bond issue of $10,000 for the installation of an electric lighting system. T. P. Howard is town clerk.

Lenoir, N. C.—The United Mills Co., Hickory, N. C., plans to develop hydroelectric power on Harpers creek to generate 1400 hp.

Midway, N. C.—The Midway Lighting & Improvement Co., recently organized with a capital stock of $50,000, will operate a local electric system. C. C. Stonestreet is head.

Randleman, N. C.—The Common Council is arranging for a bond issue for the purchase of the local plant of the Randolph Power Co. The property will be operated under municipal ownership. A number of extensions and improvements are planned.

Winston-Salem, N. C.—The City Council is considering a bond issue for extensions and improvements in the local light and power system.

Charleston, S. C.—The Charleston Consolidated Railway, Gas & Electric Co. has filed notice of increase in its capital stock to $5,500,000 for proposed extensions and improvements in its electric plant and system. C. J. Bendt is secretary and treasurer.

Columbia, S. C.—The Columbia Railway & Navigation Co., care of J. Fraser Lyon, Columbia, has applied to the Federal Power Commission for a preliminary permit to construct a navigable canal 24 mi. long from Ferguson on the Santee river to Moncks Corner on the Cooper river, and to develop power near the southern end of the canal for public utility purposes.

Alma, Ga.—The Common Council has preliminary plans under way for the installation of a municipal electric light and power plant. J. H. McDonald is city clerk.

Atlanta, Ga.—Electrical and mechanical equipment will be installed by the Board of Public Works in connection with proposed extensions and improvements in the waterworks system, bonds for which to an amount of $2,250,000 have been approved.

Bibb City, Ga.—The City Council is planning a bond issue of $30,000 for the installation of an electric street-lighting system.

Tallahassee, Fla.—The City Council is arranging a bond issue of $200,000 for the erection of an electric light and power plant, plans for which will be prepared shortly. Address J. G. Greer, city manager.

Tampa, Fla.—The Peninsula Telephone Co. is completing negotiations for the purchase of the Highland Telephone Co. The system will be extended and a number of improve-

ments made. New lines will also be constructed between Tampa, Lakeland and Mulberry. The work is estimated to cost $250,000.

NORTH CENTRAL STATES.

Canton, O.—Bids were received this week for furnishing eight motor-driven centrifugal water pumps of 1050 g.p.m. capacity each, and one centrifugal water pump with a motor of about 350 g.p.m. capacity. Address L. B. Ohliger, superintendent of the waterworks department.

Hamilton, O.—The city executives have received bids for a new street-lighting system to cost $50,000. Address William F. Mason, service director.

Evart, Mich.—The Winterfield Light & Power Co. has been reorganized. The company plans to erect a dam across the Clam river in Winterfield township. Besides Tustin, the following towns will be furnished with electricity: Leroy, Marich, McBain, Lake City, Evart and Sears.

Cynthiana, Ind.—Bids will be received April 18 for the construction of electrical work as ordered by the Cynthiana Light & Power Co. Address John E. Stevens, secretary.

Indianapolis, Ind.—The Interstate Public Service Co. has filed notice of increase in its capital stock from $8,000,000 to $15,000,000.

New Market, Ind.—The New Market Light Co. has filed final notice of dissolution under state laws.

Aurora, Ill.—Stockholders of the Western United Gas & Electric Co. voted to issue $3,000,000 in preferred stock to be sold as the company needs money to keep pace with the demands for service. Specifications include additional equipment and several hundred miles of pipe and wire. Address Ira C. Copley, 208 Downer place.

Centralia, Ill.—A committee has appeared before the City Council to explain the matter of the proposed "white way" system of lighting. Address William Hutter.

Lena, Ill.—The Lena Electric Light & Power Co. has acquired the lighting plant at Martintown, Wis., which plant also supplied the power to Winslow. A line will be built from Lena to Martintown. Plans are now under way to supply Monroe with power.

Sterling, Ill.—A proposition has been presented to the City Council calling for the installation of 77 new ornamental lamps and the improvement of the present system by replacing the globes with new ones to match those to be used in the new project. Address C. J. Stahl.

Kaukauna, Wis.—It is planned to spend $30,000 on improvements to the light and water systems. Address the mayor.

Viroqua, Wis.—The Wisconsin-Minnesota Light & Power Co. is spending $30,000 on improvements to the plant's distributing system here and in the vicinity.

St. Paul, Minn.—The citizens will vote shortly on the question of issuing $500,000 bonds to finance the development of 10,000 hp. from the high dam. Address Oscar Claussen, city engineer.

Eminence, Mo.—H. S. Shaner has applied to the Federal Power Commission for a preliminary permit to construct dam and power house in Current river, just below the mouth of Jacks fork, 4 mi. northeast of Eminence in Shannon county, for public utility purposes.

Kirksville, Mo.—The Raven Coal Co., 6 mi. from Glenwood, will run a transmission line Glenwood, Lancaster and Downing, and will supply those towns with electrical energy.

Springfield, Mo.—The Springfield Gas & Electric Co. is planning the construction of an extension to its lines to the Sunshine school district.

SOUTH CENTRAL STATES.

Boynton, Okla.—The Town Council has awarded a contract to the Oklahoma Gas & Electric Co. for the installation of a new street-lighting system, to comprise a number of arc lamps.

Dallas, Tex.—The Dallas Power & Light Co. is planning an extension of the street-lighting system on South Ervay street, from Commerce street to the city park. The cost is estimated at $35,000.

Fredericksburg, Tex.—The Fredericksburg Light & Power Co. is planning the rebuilding of its local electric power plant, recently destroyed by fire. The work will be carried out under the auspices of the local citizen's committee. H. A. Ries, vice-president and general manager of the Fredericksburg & Northern Railway Co., is in charge.

Hallettsville, Tex.—The City Council is planning extensions and improvements in the municipal electric lighting plant. Considerable new equipment will be installed, including engine, boiler, feed-water heater, and auxiliary operating apparatus. S. M. Kuykendall is city secretary.

Whitney, Tex.—The lighting plant owned by C. Gollihar burned recently. Steps will be taken at once to replace the lighting system.

WESTERN STATES.

Denver, Colo.—Plans were drawn at the initial meeting of the Rocky Mountain Radio Association for the establishment in Denver of one of the largest amateur wireless-telephone stations west of the Mississippi river. Address W. L. Winners, supervisor of the wireless station.

Thermopolis, Wyo.—The city lighting plant sustained a loss of $50,000 by fire recently.

San Francisco, Cal.—The Rich Point Mining Co., W. S. Tevis, president, 57 Post street, San Francisco, has applied to the Federal Power Commission for a preliminary permit to construct a diversion dam in Bear creek and conduit to power house on the middle fork of the Feather river in Plumas county, California. The project is to provide pumping facilities for mining purposes.

Butte, Mont.—The Boston and Montana Milling & Power Co. has applied to the Federal Power Commission for a license to construct a transmission line 22 mi. long from Big Hole river to a mill in the Lewis and Clark National Forest, in Beaverhead county, to generate power for milling purposes.

INCORPORATIONS.

Brantford, Ont.—Thermo Electric Co., Ltd. Capital, $60,000. To manufacture electrical apparatus, machinery, etc. Incorporators: Edmund Sweet, Archibald M. Harley and James Harley.

Aurora, Ont.—Matson & Co., Ltd. Capital, $40,000. To manufacture electrical fixtures, motors, etc. Incorporators: Reginald R. Matson, William G. Cole and William H. Bushnell.

Pittsburgh, Pa.—Wire Electric Co. Capital, $100,000. To engage as electrical engineers. Incorporators: Charles G. Wire, A. S. Dailey and L. L. Ditmer.

Boston, Mass.—Anderson-Coffey Co. Capital, $25,000. To engage in electrical engineering and construction. Frederick P. Coffey, president, and Charles W. Anderson, 16 High street, treasurer.

Boston, Mass.—J. Comer Jones Power & Pump Co. Capital, $20,000. To manufacture electrical pumping machinery and other kindred equipment. William E. Fennell, president, and J. Comer Jones, 21 Winchester street, Brookline, Mass., treasurer.

Providence, R. I.—The E. E. Young Electric Co., 221 Knight street, has filed notice of organization to manufacture and deal in electrical specialties. Ernest E. Young heads the company.

Brooklyn, N. Y.—Charles Tisch, Inc. Capital, $300,000. To manufacture electrical appliances and equipment. Incorporators: J. J. Ryan, M. and Charles Tisch, 31 Irvington place.

New York, N. Y.—Watson Electric Co. Capital, $5000. To engage as electrical engineers. Incorporators: F. Warnock, G. Haustein and C. M. Watson, 1373 White Plains avenue, Bronx.

FOREIGN TRADE.

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Apparatus (34,645)—A trading company in Australia desires to secure an agency for the sale of all classes of electrical goods, switches, holders, connections, lamps, motors and generators (large and small). The voltage principally used is 240. Quotations should be given c. i. f. Australian port. References.

Electrical Goods (34,666)—A trading company in Australia desires to purchase electrical goods, electrical wire and cables, and raw materials of all kinds for Australian manufacturers. Quotations should be given c. i. f. Sydney and f. o. b. New York. References.

Patented Superheater (34,674)—A metallurgical products society in France is desirous of being placed in connection with an American manufacturer having a patented superheater who would grant an exclusive agency for its manufacture and sale in France. No reference offered.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Detroit Edison Co. Gold Bonds Offered to Public.

An issue of $2,750,000 Detroit Edison Co. 6% first and refunding mortgage gold bonds, dated July 1, 1915, and due July 1, 1940, is being offered at 88.5 and interest, yielding over 7.1%, by the Harris Trust and Savings Bank, Spencer Trask & Co., Chicago, and other bankers. It is stated that the net earnings of the Detroit Edison Co. are over twice the annual interest on the mortgage bonds. The earnings as officially reported for the year ending Feb. 28, 1921, are as follows:

Gross earnings	$22,488,734.97
Operating expenses, including maintenance, depreciation, reserve and taxes	17,751,330.79
Net earnings	4,737,404.18
Annual interest on mortgage bonds (including present issue)	2,298,250.00
Balance	2,439,154.18

Dividends Declared by Middle West Utilities Co.

The Middle West Utilities Co. at a meeting of the board of directors held last week declared a dividend of $1.50 a share upon the preferred stock. Under the reorganization of the finances of the Middle West Utilities Co., the preferred stock dividend is cumulative at 3% for the year starting June 15, 1920; 4% for the year starting June 15, 1921; 5% for the year starting June 15, 1922; 6% for the year starting June 15, 1923; 7% for the year starting June 15, 1924, and thereafter. The action taken by the board provides for the payment of the accrued dividend for the first half of the year starting from June 15, 1920.

Permission Granted to Renew Bond Issue.

The Board of Public Utilities has granted the Public Service Railway Co., Newark, N. J., permission to renew a bond issue of $500,000 for its subsidiary organization, the Rapid Transit Street Railway Co., at 8%. In connection with its decision, the board states that the action is to tide over an emergency and "will not commit itself to a recognition of 8% as a proper guaranteed return in the sale of traction securities."

Wants Authority to Issue Stock.

The Western United Gas & Electric Co., Aurora, Ill., has received permission to increase its capital stock to $5,000,000. The company asks authority to issue $1,500,000 of this stock immediately and to exchange the same amount for $1,500,000 6% preferred stock outstanding.

Allis-Chalmers Manufacturing Co.

For the quarter ended Dec. 31, 1920, sales billed amounted to $9,558,063; net profits after provision for federal taxes were $1,038,962, and unfilled orders on hand Dec. 31, 1920, aggregated $17,046,724.

Southern California Edison Co.

Month of January.	1921.	1920.
Gross earnings	$1,270,278.20	$857,830.05
Expenses and taxes	443,257.48	438,255.73
Net earnings	827,020.72	419,574.32
Fixed charges	274,271.00	234,778.35
Balance	552,749.72	184,795.97
12 Mo. ending Jan. 31, 1921—		
Gross earnings	$15,060,344.47	$10,626,901.65
Expenses and taxes	6,418,686.27	4,639,900.21
Net earnings	8,641,658.20	5,987,001.44
Fixed charges	3,201,909.07	3,094,672.41
Balance	5,439,749.13	2,892,329.03

Westinghouse Air Brake Co.

For the year ended Dec. 31, 1920, net income after federal taxes was $5,330,403, equal to $9.15 a share ($50) par value) earned on the $29,127,350 capital stock outstanding. This compares with net income of $6,287,569, or $10.80 a share earned on the outstanding $29,087,750 stock in 1919.

Appalachian Power Co.

	1921.	1920.
February gross	$ 186,220	$ 161,476
Net after taxes	93,254	84,722
Total income	94,421	84,722
Surplus after charges	11,218	19,335
12 mo. gross	2,351,407	1,701,357
Net after taxes	1,049,300	796,509
Total income	1,052,800	796,509
Surplus after charges	142,339	41,497
Balance after preferred dividends	121,698	41,497

Note—In February, 1921, $20,833 was charged off for depreciation against $10,500 in February, 1920.

Adirondack Power & Light Corp.

	1921.	1920.
February gross	$ 370,355	$ 355,047
Net after taxes	144,531	55,190
Surplus after interest charges	79,408	5,742
12 mo. gross	4,774,978	3,971,792
Net after taxes	1,374,830	1,315,749
Surplus after interest charges	588,792	730,489

Note: Operating expenses include 12.5% of gas and electric revenues to cover current maintenance charges and credits to renewals and replacements.

Utah Securities Corp. Subsidiaries.

(Intercompany charges are eliminated.)

	1921.	1920.
January gross	$ 816,018	$ 728,635
Net earnings	417,401	363,266
12 mo. gross	8,678,589	7,432,719
Net earnings	4,140,829	3,792,674

Alabama Power Co.

	1921.	1920.
February gross	$ 383,786	$ 325,735
Net after taxes	207,967	202,369
12 mo. gross	4,339,602	3,086,207
Net after taxes	2,190,371	1,656,888

Subsidiary Southwestern Power & Light Co.

	1920.	1919.
December gross	$ 978,828	$ 705,841
Net earnings	418,829	345,163
12 mo. gross	9,514,350	6,409,736
Net earnings	3,435,926	2,371,796

Subsidiary of General Gas & Electric Co.

	1921.	1920.
February gross	$ 936,541	$ 834,499
Net after taxes	265,236	220,821

Philadelphia Co. and Subsidiaries.

	1921.	1920.
February gross	$1,360,409	$1,637,878
Net earnings	579,858	819,747
2 mo. gross	2,919,649	3,249,253
Net earnings	1,290,369	1,561,023

United Gas & Electric Corp.

	1921.	1920.
February gross	$1,093,233	$1,030,715
Net after taxes	352,495	366,934
Total income	366,228	382,973
Surplus after charges	134,834	168,122
12 mo. gross	12,276,858	10,621,774
Net after taxes	3,615,478	3,646,876
Total income	3,906,686	3,860,326
Surplus after charges	1,359,649	1,541,279

Dividends.

	Term.	Rate.	Payable.
Am. Lt. & Tr., com.	Q	1%	May 2
Am. Lt. & Tr., com. stk.	..	1%	May 2
Am. Lt. & Tr., pfd.	Q	1.5%	May 2
Carolina Pr. & Lt., com.	Q	0.5%	May 2
Crocker-Wheeler	Q	2%	Apr. 15
Crocker-Wheeler, pfd.	Q	1.75%	Apr. 15
Ed. El. Illum. (Brockton)	Q	$2.50	May 2
Illinois Nor. Util., pfd.	Q	1.5%	May 2
Middle West Util., pfd.	Q	$1.50	May 14
Mil. El. Ry. & Lt., pfd.	Q	1.5%	Apr. 30
Nor. States Pr., pfd.	Q	1.75%	Apr. 20
Pub. Ser. of N. Ill., com.	Q	$1.75	May 2
Pub. Ser. of N. Ill., pfd.	Q	$1.50	May 2
S. Diego Con. G. & E., pfd.	Q	1.75%	Apr. 15
West. Penn. Pr., pfd.	Q	1.75%	May 2
W. States G. & E., pfd.	Q	1.75%	Apr. 15

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Apr. 4.	Bid Apr. 11.
Adirondack Electric Power of Glenns Falls, common	6	10	10
Adirondack Electric Power of Glenns Falls, preferred	6	71	71
American Gas & Electric of New York, common	..	101	101
American Gas & Electric of New York, preferred	6	37	37
American Light & Traction of New York, common	..	92	92
American Light & Traction of New York, preferred	6	82	82
American Power & Light of New York, common	4	51	51
American Power & Light of New York, preferred	6	70	71
American Public Utilities of Grand Rapids, common	..	7	7
American Public Utilities of Grand Rapids, preferred	7	17	17
American Telephone & Telegraph of New York	..	106	105
American Water Works & Elec. of New York, common	..	4	4
American Water Works & Elec. of New York, particip	7	7	7½
American Water Works & Elec. of New York, 1st preferred	..	45	46
Appalachian Power, common	..	3	3
Appalachian Power, preferred	7	25	24
Cities Service of New York, common	+extra	233	234
Cities Service of New York, preferred	6	66½	66½
Commonwealth Edison of Chicago	8	108	108
Comm. Power, Railway & Light of Jackson, common	..	12½	11
Comm. Power, Railway & Light of Jackson, preferred	6	32	31
Federal Light & Traction of New York, common	..	6½	6½
Federal Light & Traction of New York, preferred	..	43	42
Northern States Power of Chicago, common	..	47	47
Northern States Power of Chicago, preferred	ex.div.7	78	79
Pacific Gas & Electric of San Francisco, common	..	46	46
Public Service of Northern Illinois, Chicago, common	7	75	75
Public Service of Northern Illinois, Chicago, preferred	6	82	82
Standard Gas & Electric of Chicago, common	..	11	11
Standard Gas & Electric of Chicago, preferred	8	35	35
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	5	5½
Western Power of San Francisco, common	..	24	24
Western Union Telegraph of New York	..	90	91
Industrials—			
Electric Storage Battery of Philadelphia, common	4	97	97
General Electric of Schenectady	8	135	132
Westinghouse Electric & Mfg. of Pittsburgh, common	7	47½	47½